SCIENTIFIC AMERICAN

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IRON AND STEEL IN LARGE BUILDINGS—THE PALACE HOTEL, DENVER, COL.—[See page 325.]

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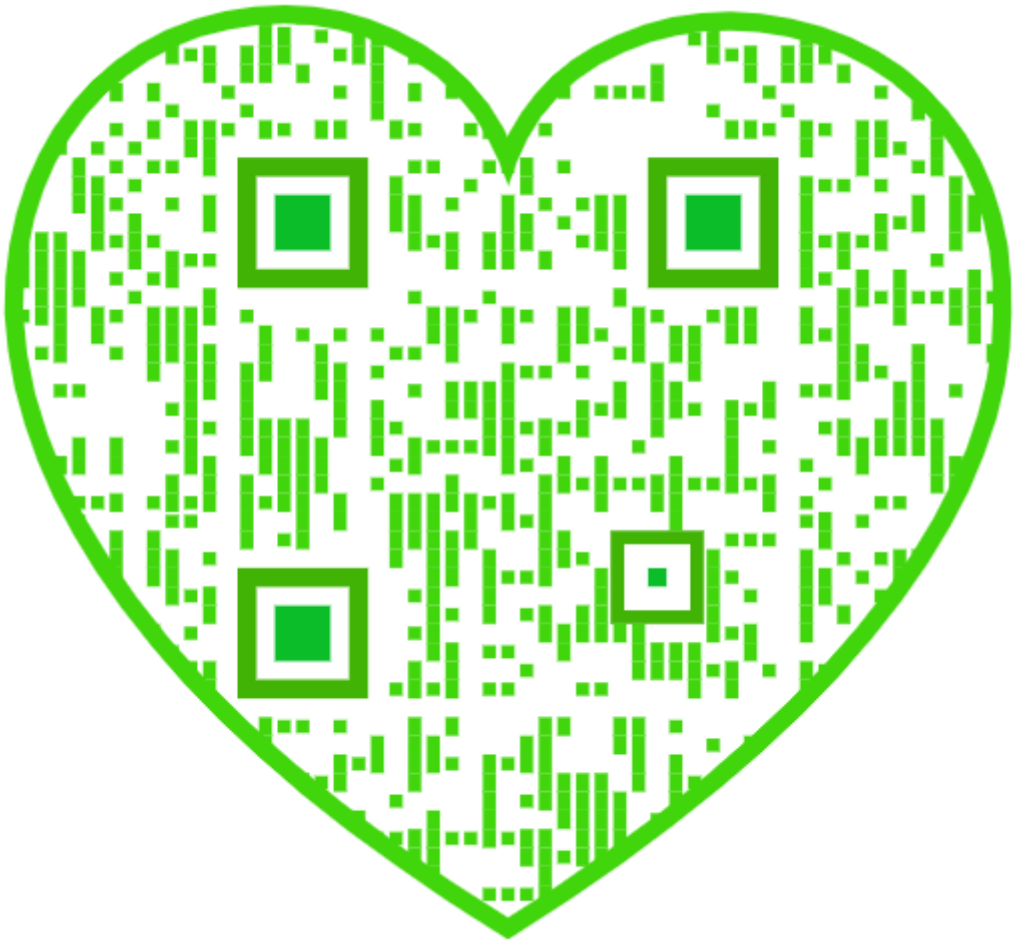

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FAST SHIPS IN PROSPECT.

The thanks of the country are due to Mr. Bourke Cockran, of the House of Representatives, and to Mr. Frye, of the Senate, for their very able and successful advocacy of the bill for the American registration of those two noble specimens of marine construction, the City of New York and the City of Paris. Both ships, although built and sailing under the British flag, are principally owned by American citizens. The shipping laws of this country are intended to promote and encourage American naval industry, and hence, except by special act of Congress, no foreign-built vessel is allowed to carry our flag or engage in our coastwise commerce.

The necessity of providing the country with a fleet of superior ships of the highest speed and greatest coal endurance, for long voyages, has of late become extremely urgent. For years the SCIENTIFIC AMERICAN has advocated the construction of such ships as adjuncts for our navy in case of hostilities; and we are heartily gratified at the prospect which now presents itself of an early and ample realization of the project. It now looks as if the United States were about to enter upon a new era of maritime progress, which may ultimately result in the restoration of the ocean prestige we formerly enjoyed, before civil war made havoc with our sailing ships and foreign steamers grasped our trade.

The admission to registration of the two great ships we have named is coupled with the condition that they are to be subject to the use of the Navy Department in case of emergency, and that the Inman Company, to which they belong, shall immediately contract for the construction, in this country, of two additional ships of at least equal speed and strength. Our shipbuilding industry will thus at once receive a new and powerful impetus. Every effort will be made to render the new vessels superior in velocity and strength to any afloat, and this good beginning will doubtless lead to the permanent establishment of shipyards and appliances that will enable our workmen to compete with the world in every department of naval architecture. Since the passage of the act in favor of the two steamers mentioned, we notice that the Pacific Mail Steamship Company is about to apply for registration, on similar terms, for one of their large ships, now carrying the English flag, the China, which plies between San Francisco and Japan. The company agrees, in case registration is allowed, to build in this country two new and splendid boats, which, like the registered vessels, are to be subject to the call of the Navy Department. We give herewith portraits of the City of New York and the City of Paris, which are twin ships, and subjoin the following particulars.

The ships were built in 1887–88 by Messrs. Thomson, Clydebank.

Length over all	560	feet.
Breadth	63¼	"
Depth moulded	42	"
Tonnage (gross)	10,500	tons.
Displacement	13,000	"
Cylinders, two 45 in., two 71 in., two 113 in.		
Piston stroke	5	feet.
Boiler heating surface	50,265	sq. ft.
Grate area	1,293	feet.
Steam pressure	150	lb.
Indicated horse power	18,350	"

Of the speed to which they attain, it may not be uninteresting to show how their dimensions compare with those of other notable Atlantic steamers of the present and of bygone days, a comparison which we give in tabular form.

TABLE GIVING CHIEF DIMENSIONS OF NOTABLE ATLANTIC LINERS.

	Built.	Tons.	Length.	Beam.	Depth.	Proportion of Beam to Length.	Proportion of Depth to Length.
			ft. in.	ft. in.	ft. in.		
*Great Western....	1835	1,340	212 4	35·4	23·2	5·99	9·15
*Great Britain.....	1841-3	3,500	274·2	48·2	31·5	5·68	8·70
†City of Glasgow...	1850	1,600	227	32	24	7·09	9·45
†Britannic	1874	5,004	455	46	34	9·89	13·38
†City of Berlin.....	1875	5,491	488	44	36¼	11·90	13·46
†Gallia.....	1879	4,809	430	44	36	9·77	11·94
†Arizona...	1879	5,147	450	45 2	37½	9·96	12 00
‡Servia....	1881	7,392	515	52	40¾	9·90	12 62
†Alaska.....	1881	6,932	500	50	39 7	10·0	12·63
†City of Rome.....	1881	8,141	546	52	58¾	10·5	9·29
‡Aurania...	1882	7,269	470	57	39	8·24	12·05
†Oregon.....	1883	7,375	500	54	39¾	9·25	12·57
‡America.....	1884	6,500	432	51	37½	8·47	11·52
‡Umbria & Etruria.	1884	7,718	501·6	57·2	38·2	8·76	13·13
‡Salle	1885	5,381	455	48	36 3	9·47	12·55
‡Lahn.....	1887	5,661	465	49	36½	9·48	12 83
‡City of New York and City of Paris.	1888	10,500	560	63	43	8·89	13·02

NOTE.—Those marked * were built of wood, † of iron, and ‡ of steel.

The keel of the City of New York was laid in June, 1887, and that of the companion ship, the City of Paris, shortly afterward. The vessels are constructed of steel made at the works of the Steel Company of Scotland, Newtown and Blochairn, and at the Mossend Steel Company's works. The material placed in position when the ships were almost ready for launching weighed, for each vessel, 7,000 tons, the heaviest casting for each ship being the stern post of 26 tons. The heaviest casting for the engines weighs 50 tons. The steel was thoroughly tested at the makers, under Lloyds' supervision, and carefully treated by a special process to remove as much as possible the chance of corrosion. The vessels were built throughout on the most approved principles of modern ship construction, and in many respects bold innovations, based on exhaustive scientific experiments, were introduced. The hull of each vessel is divided by transverse bulkheads into fifteen watertight compartments, including three for boilers and two for machinery, the latter being separated by a longitudinal bulkhead. The vessels have two bottoms, the space between them being 4 ft.

The vessels have each five decks. The total number of square feet on each deck is 27,000, so that, including the bottom of the hold, the vessels have each a flooring of over 150,000 square feet. The saloon is on the main deck, and forms a principal feature in the internal arrangements. A condition was that the vessels were to partake more of the arrangement of large first class hotels than of steamers. Eight feet is the usual space between two decks, and even the most skillful architect would find it difficult, if not impossible, to produce a saloon commensurate, either in size or artistic treatment, with the proportions and general design of such large vessels. Messrs. Thomson, however, solved this problem in the national liner America, and as the experiment in her case was most successful in every way, they have repeated the same arrangement greatly improved, making the roof of the saloon in the form of a large dome or arch. In the case of the new Inman, the saloon dome is level with the top of the houses on the upper deck, thus giving a height of 22 feet. The dome is 53 feet long and 25 feet wide. It is supported by heavy steel stanchions, the arch itself being formed of strong yet light framework of steel.

In designing the steering arrangements for these vessels, it was considered desirable to make them thoroughly efficient for war purposes in the event of the ships being used as armed cruisers, a condition which is not by any means fulfilled by the steering gear fitted to ordinary merchant steamers. The gear is powerful enough to put the rudder hard over when the ship is going full speed ahead, each hydraulic ram being capable of exerting a thrust of 80 tons, which is increased by the nature of the mechanism to 140 tons on the connecting rod, which is a shaft of steel 12 inches in diameter. The hydraulic pressure by which the rams are actuated is taken from the pressure main, which extends to the different parts of the ship, and the valves which admit pressure to one or other of the two rams are controlled by the quarter-master on the bridge by the motion of a small tiller, which takes the place of the usual wheel, and is said to admit of greater accuracy in keeping a given course. The position of the rudder is indicated on the bridge by a simple arrangement.

The ships are propelled by twin screws. The Inman Company was the first to adopt both the single and the twin screws in the Atlantic trade. The propellers are supported by two massive steel stays, each of which is a casting of steel weighing 26 tons and made by the Steel Company of Scotland.

The machinery consists in each vessel of two sets of engines of the three-crank triple expansion type, having piston valves throughout. Each set of the engines is capable of exerting sufficient power to propel the vessel at four-fifths of her maximum speed, so that should one set break down no serious delay will take place, for the vessel will go at a speed, say, of 16 knots instead of 19 knots per hour.

The auxiliary engines of each of the vessels number thirty-seven, the majority of which are driven by hydraulic power.

The average Atlantic passage of these boats is 6 days 2 hours, and the average speed of the voyages 19·20 knots, or a little over 22 miles per hour.

Senator Frye in advocating the bill to register these ships said:

"They have been specially designed and built to be not only the finest passenger ships afloat, and the safest, but also the most efficient commerce destroyers and cruisers. They have frequently crossed the Atlantic exceeding a speed of 20 knots for the whole distance, taking good and bad weather together.

"They have a remarkable coal endurance, capable of keeping at sea for seventy-two days, and steaming 10 knots, which is a valuable qualification as a cruiser. They are already fitted for sixteen rifled cannon. They were built under the inspection and according to the design of the British Admiralty, to the end that they might be efficient cruisers. Their boilers and engines are divided into separate compartments, so that the steamer could never be disabled by the floating or flooding of one or more compartments. Their boilers are protected from ramming or from shot by the coal bunkers on either side in water-tight compartments. Their engines are protected in the same manner by water-tight compartments, which can be filled with any suitable material when being fitted as cruisers. Their rudders and steering gear are under water, thus protected from shot. They are the only merchantmen afloat designed to meet all the above-described important qualifications as cruisers. They can escape by their speed any war vessel afloat to-day. They can

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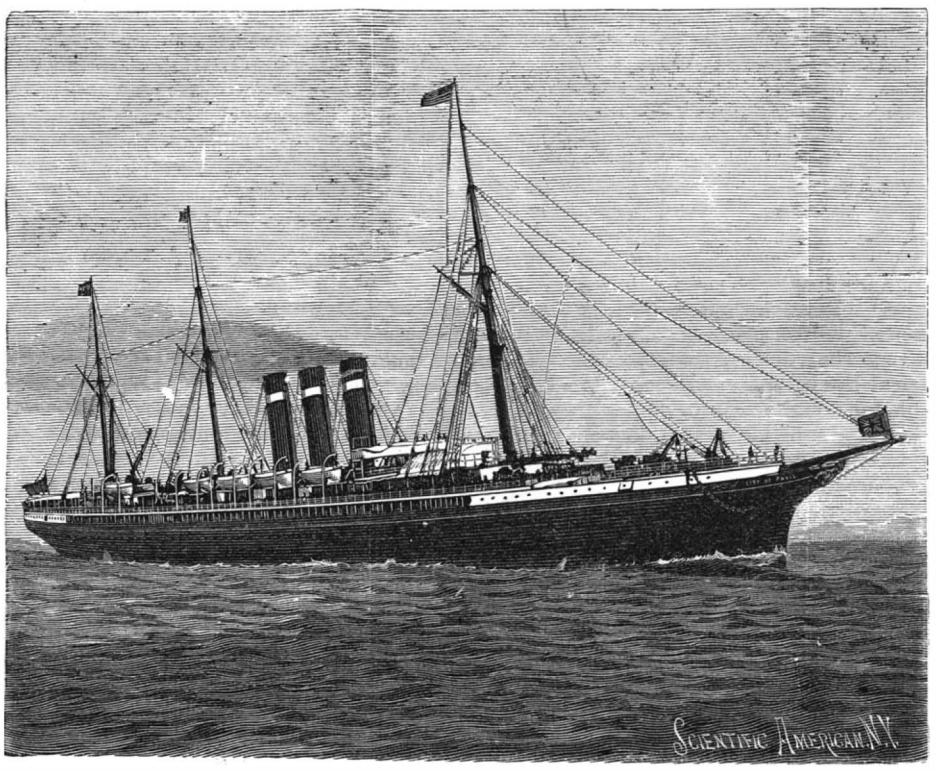
overtake and destroy any merchantman that sails on the ocean.

"They were built at Thomson's yard, on the Clyde. They cost about $2,000,000 each. The vessels which the bill provides shall be built here will cost about $2,225,000 each."

Secretary of the Navy Tracy in a recent letter to Mr. Frye says:

"It is difficult to imagine a more effective commerce destroyer than the steamship City of Paris, armed with a battery of rapid-firing guns. She can steam over 21 knots an hour, and can average 19·9 knots from land to land across the Atlantic. No man-of-war could overtake her; no merchantman could escape her. A fleet of such cruisers would sweep an enemy's commerce from the ocean. This fact is well understood in Europe, and states that are unprovided with a convertible merchant fleet are preparing to meet the possible emergency by partly protected cruisers that are substantially as fast as the City of Paris.

"The steamship City of Paris, referred to above in my annual report for 1889, and her sister ship the City of New York, are among the vessels that the United States might acquire by the passage of this bill. When it is considered that these two extraordinary ships will, by this legislation, be virtually added to the navy of the United States without cost; that the passage of the act is a guaranty that other ships equally fast and powerful will be built, which the government may likewise take advantage of in emergencies, the great importance of the measure in connection with the problem of naval defense in the United States cannot be overestimated, and I think it proper to state that although this bill involves the expenditure of no money in the Treasury, I consider it as second in importance only to the naval appropriation bill."



THE CITY OF PARIS.

Mr. Frye continues: "These two ships were built under the inspection and direction of the British Admiralty; and that Admiralty, knowing that they were built by American capital, demanded much more of these two ships than they did of any others built in England and subvented. The Majestic and Teutonic have none of the requirements, and none were made of them that were made of these two ships. They have not the coal bunker protections, and the engines and machinery are not below the water line, as they are in these two ships.

"Mr. President, I have a right to say that a ship will be built if this bill becomes a law, not of 10,000 tons, but of over 12,000, with a speed, not of 20 knots, but of 23 knots. The Cunard line now is building on the Clyde two vessels for the main purpose of surpassing these two, and the purpose of this company is to make one of these vessels a vessel that will be superior in every respect to the two Cunarders, so that one of these ships will be over 12,000 tons.

"I have a right to say further—I believe it fully—that another line of three of these great ships will be provided for, if this bill becomes a law, between New York and Antwerp, and with those the government of the United States will have seven of the finest war cruisers in the whole world. These two ships to-day are capable in two hours' time of taking on board sixteen rifled cannon and going to sea and answering a necessity which war may force upon us.

"In the last Congress the Senate passed two bills, one the tonnage bill and the other the postal subsidy bill, and I felt that I knew that if these two bills became laws we should be restored to our proper and rightful position upon the ocean, but, unfortunately, I say, the House of Representatives defeated the tonnage bill and crippled the postal subsidy bill, so that there was no inducement left for capital to build these first-class ships and put them on to these lines. Shortly after I spent a week in Philadelphia and New York, using all the powers of persuasion I was possessed of to induce capital to put these lines on, and it was a complete failure.

"I am authorized to say that some leading men and manufacturing and shipyard establishments in the United States have sent here their approval of this bill, and the names I shall read are a few of those I have received. I read them because they represent the leading friends heretofore for the rehabilitation of the merchant marine of the United States: Morris, Wheeler & Co., manufacturers of iron and steel plate, very prominent men in the Shipping League; the Phœnix Iron Company; the Pingree Iron Works; Morris, Tasker & Co.; the Cramps, shipbuilders; I. P. Morris Company, shipbuilders; James M. Swank, general manager of the American Iron and Steel Association; Penn Steel Company, shipbuilders at Sparrow Point; Handren & Robins, shipbuilders; Arthur Sewall, of the State of Maine, one of our largest shipbuilders, who just at this moment is putting in a plant to build steel sailing ships, the first in the country, I believe; Gen. T. W. Hyde, of my State, who is now building two cruisers for the American government; William P. Clyde; the Red D line, represented by its president; James E. Ward, of the Cuban and Mexican line; the president of the Brazilian line; the Metropolitan Steamship Company, represented by its president. The other names I will not read.

"The men whose names I read unite in saying:

'The admission of such a limited number of vessels to registry will not harm a single American interest, while the demand for the new vessels provided for in the bill will give an important stimulus to American shipbuilding and consequent employment to American mechanics.'"

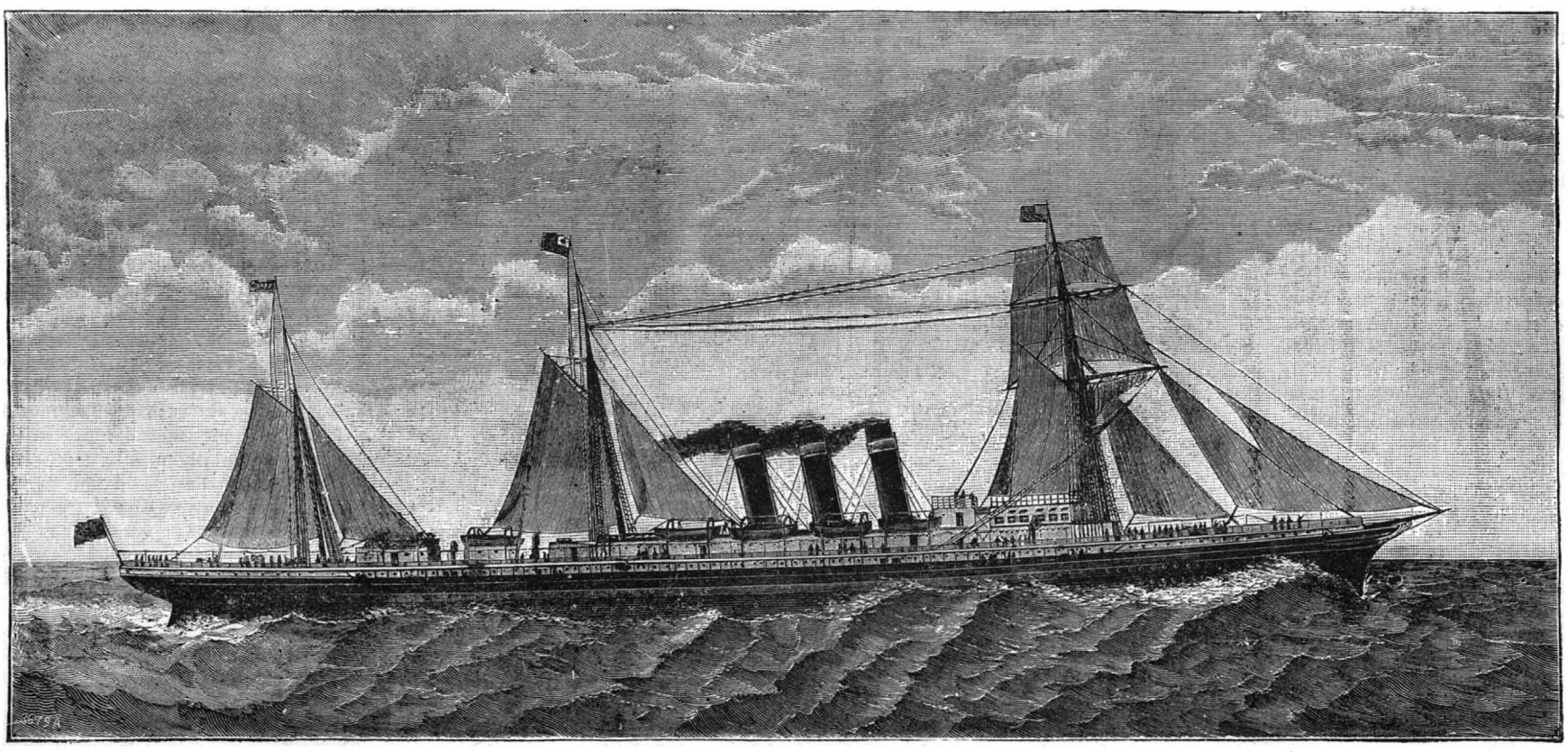
Process for Photo. Printing Plates.

Jacob Husnik, of Prague, Austria, gives the following description of his method for the production of gelatine relief plates, which, he says, yield the finest details of outlines or shaded figures in a very successful and artistic manner:

One kilogramme of soft gelatine is mixed with twenty-five cubic centimeters of glycerine and six liters of water. This is dissolved in a water bath and filtered afterward. Large sheets of strong paper or carton which have been immersed in water for about five minutes are stretched upon a plate of glass horizontally and small rims or flaps are formed on their edges. A layer of about three-quarters of a millimeter in thickness of the gelatine solution is poured upon said paper. After sufficient hardening of the gelatine sheets they are hung up to dry. After that they can be kept in store for years ready for use at any time.

The sheets of gelatine just mentioned are to be bathed for ten minutes in a solution of one part of potassium bichromate, twenty-five parts of water, and as much caustic ammonium as will make the bath yellow. The sheet is then spread upon a sheet of glass which has been covered with a film of wax in the same way as is done in the preparation of the so-called "pigment papers." The gelatine must then be dried in the dark. The sensitive sheet is then exposed under the negative glass, or in case of a figure with shades, under the positive glass, in the sun for about half an hour. The figure appears brown on a light yellow ground. The sensitive sheet is then laid in a large zinc dish, or any appropriate vessel, and a concentrated solution of sodium bichromate (1·8) is poured upon it. The sheet has to be rubbed with said solution by means of a brush, which must not be too stiff, or in any other way, so as to take off the superfluous gelatine from the carton or paper. The drawing remains upon it in elevated lines or traces. The relief is then washed and dried, and is ready for use.

In case of fire somebody asserts that a wet silk handkerchief, tied without folding over the face, is a complete security against suffocation by smoke; it permits free breathing, and at the same time excludes the smoke from the lungs.



THE CITY OF NEW YORK.

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The Virginia Dismal Swamp.

The name of the Dismal Swamp, as well as its natural curiosities, has given it a weird interest. It is a little and curious world in itself, having its own vegetable and animal life. J. Ralph, in the *American Agriculturist*, gives the following description:

The Dismal Swamp in Virginia, one of the largest of the swampy tracts in America, is also one of the most promising areas for reclamation. It contains fully 1,500 square miles, and is at present of little value, except for a supply of timber, which is constantly diminishing. The swamp is situated on an inclined plane, gently undulating, and is really nothing but a continuation of the low, swampy, coastal plain which extends from Texas northward. It is an old sea bottom, and the western boundary of the swamp is a sea cliff and beach. Owing to the original deficiency of slope, it is swampy because the water cannot run off, and its swampy nature is increased by the growth of vegetation, which acts like a sponge in retaining water.

Near the center of the swamp is the famous Lake Drummond, about which so much has been written, and the origin of which is still an unsettled question. It has been supposed that during some time of drought a fire, burning the peat, has produced a large depression in which the waters of the lake have gathered. Prof. Shaler, of the United States Geological Survey, considers this explanation to be improbable, although smaller pools have been produced in this way. He offers as a theory that as the vegetation grew upon the old sea bottom, which had been raised to dry land, it began to grow first on the margin, and gradually to extend over the entire area, Lake Drummond being the last place to be filled. One of the most interesting features connected with the Dismal Swamp is its peculiar vegetation. Trees generally cannot grow in very swampy tracts, for their roots need to have access to the air during the growing season. The bald cypress (*Taxodium distichum*) under ordinary conditions differs in no way from an ordinary tree with respect to its roots; but in swamps such as the Dismal Swamp, where the roots are beneath water all the year, it has formed the habit of sending a knee-like protuberance from the roots up above the water into the air—breathing holes one might say, for the roots. In this way the cypress can live in very wet swamps. The black gum of the Dismal Swamp accomplishes the same end by arching its roots so as to raise portions of them above water.

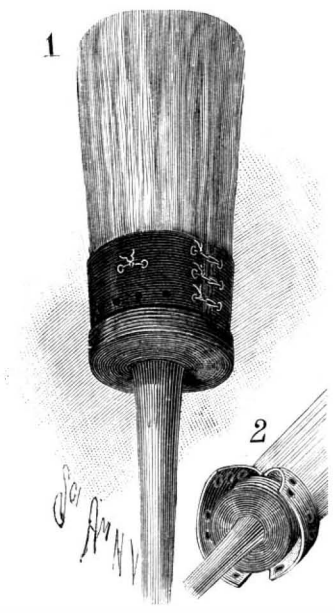
As would be expected, the animal life of this great swamp is also peculiar. No squirrels exist because there are no nuts; ground-loving animals are also absent because of the extreme wetness, so that there are no mice, moles, squirrels, or other animals of this class. Birds which build on the ground cannot live here, and the chief animal population of the higher classes consists of water birds and snakes. Of the larger animals, bears are abundant, and there is a peculiar and very ferocious species of wild horned cattle. These animals, probably the descendants of former domesticated cattle, are now thoroughly wild and very dangerous. The fights of the wild bulls are said to be very exciting by those who have seen them, and in the contests between the bears and bulls both are sometimes killed. It is said the bears, in order to escape the danger from the horns of the cattle, have the habit of springing upon their backs and rending the muscles supporting the head of their prey.

This region is in part a wilderness, but some efforts have been made to drain it, though these have been in the main unsystematic and unscientific, and have produced little result of value. Prof. Shaler estimates that by a proper system of draining this great swamp, fully 160,000 acres of land can be reclaimed at a cost of $4,000,000, making the land worth some $16,000,000. The region is very favorably situated for cultivating and marketing garden crops. Experiments already made prove the soil and climate to be admirably adapted to the cultivation of vegetables. The Norfolk district, where a costly system of fertilizing is necessary, now furnishes a large part of the supply of such crops to from four or five million people along the northern coast, and the demand is certain to increase. The drainage channels could furnish water transportation to within a mile of every part of the tilled area and thence to the sea.

AN alloy of gold and aluminum has recently been made. Its color is a most beautiful purple, and it will be valuable in making jewelry.

AN IMPROVED PAINT BRUSH BRIDLE.

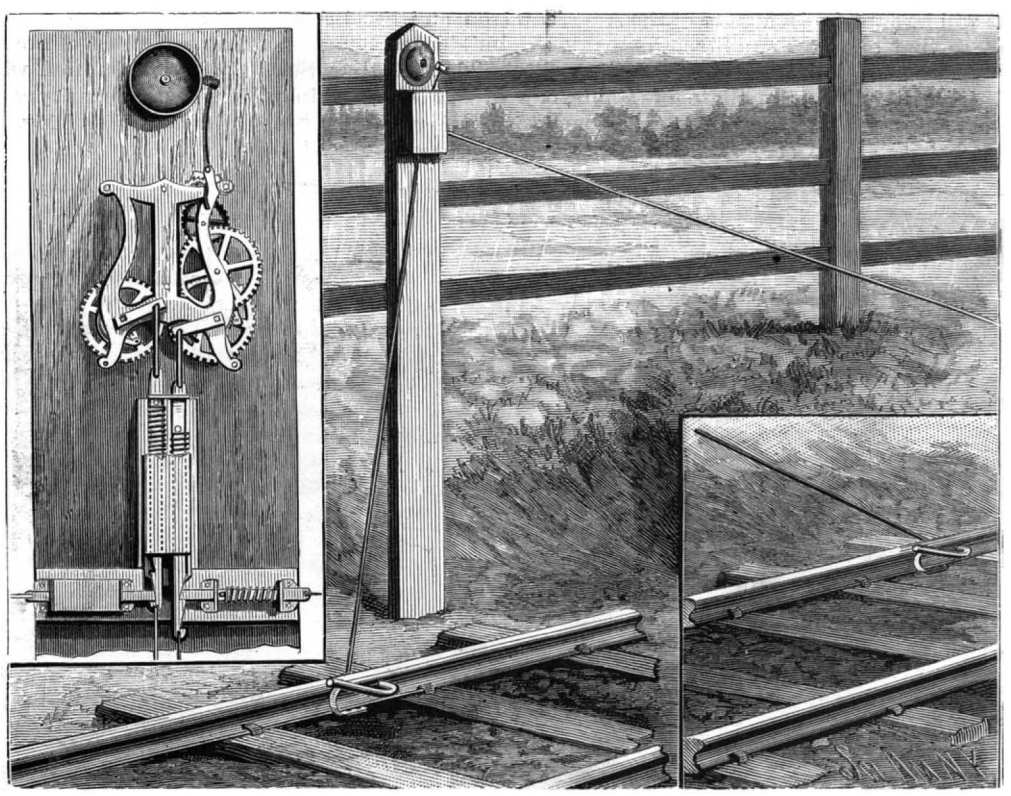
The improvement shown in the illustration is designed for application to paint brushes of all kinds, facilitating the working out of the coloring matter, and enabling the brush to be flattened as desired. It has been patented by Mr. Wm. H. Humphrey, of the United States Hotel, New York City. Fig. 1 is a view in perspective and Fig. 2 shows the bridle turned back in position for cleaning the brush. The bridle takes the place of the usual twine wound around the butt of the brush, and consists of two similar pieces or flaps, held at one end between the plug and the brush ferrule, the edges of the flaps having eyeleted perforations to be connected in pairs by cords. When the brush becomes worn the outer ends of the flaps with the outer cords may be cut off to give further flexibility, as this may be desired. Near the center of the flaps are other eyeleted perforations to receive a cord extending transversely through the bristles and back again, portions of the cord lying at each side of the center, and its ends being tied at one side. If the brush is to be round, the cord is left loose enough to permit the bristles to assume a cylindrical shape, but by tightening the cord the brush is flattened accordingly. Near the base of the flaps are perforations, through which the paint oozes when the brush is worked back and forth to free it of a certain color, but when the brush is to be thoroughly cleaned, the flaps are turned back, as shown in Fig. 2.



HUMPHREY'S PAINT BRUSH BRIDLE.

AN IMPROVED RAILWAY SIGNAL.

The illustration represents an improved means for actuating an audible or visible signal, to be located adjacent to a railway crossing, for indicating the approach of a train, the signal being operated by the train. The improvement has been patented by Mr. Owen C. Morris, of Phœnix, Md. The figure at the left shows the details of the signal-operating mechanism, adapted for connection with a rail of the track at either side of the crossing, the apparatus being inclosed in a suitable casing, attached to a post at the side of the track. The mechanism, by means of which an alarm is sounded on a bell or gong, is operated by two spring-actuated driving wheels, the shafts on which the wheels are mounted being rigidly connected at their outer ends with crank arms, pivotally connected with links extending to the upper ends of vertically movable slides in a casing which is shown partially broken away. Sleeved on the slides are spiral springs, whose lower ends abut against the lower end of the frame and their upper ends against lugs on the slides, so that as the latter are drawn down, the springs are compressed. The lower projecting ends of the slides are formed with stops adapted to be engaged by spring-pressed horizontal bolts, sliding in brackets, the outer end of one of the bolts being connected by cable or wire with a tripping lever located on the rail at some distance from the signal. These levers are so inclined that the wheels of a passing train, approaching the signal in one direction, will press the lever down and thus draw upon the wire or cable to withdraw the bolt, releasing the slide, and permitting the spring to force it up, thereby operating the clock mechanism to sound the alarm. As the train reaches the signal, a similar tripping lever on the rail is operated to draw down the slide, a wire extending from this lever to the bottom of the slide, which is now engaged and locked by the horizontal bolt, the device being then in readiness for the following train, the signal having been sounded from the time the first tripping lever was moved until the second one was reached. To prevent unauthorized persons or animals from operating the signals, C-springs of sufficient strength are placed under the tripping levers.



MORRIS' RAILWAY SIGNAL.

A Great Tableland 17,000 Feet High.

Captain Bower, of the Indian Staff Corps, has arrived at Simla from China, after a very remarkable journey across the Tibet tableland. He had with him, says *Nature*, Dr. Thorold, a sub-surveyor, one Pathan orderly, a Hindostani cook, six caravan drivers, and forty-seven ponies and mules. The Calcutta correspondent of the *Times*, who gives an account of the journey, says that Captain Bower, leaving Leh on June 14, crossed the Lanakma Pass on July 3, avoiding the Tibetan outpost placed further south. Journeying due east, he passed a chain of salt lakes, one of which, called Hor-Ba-Too, is probably the highest lake in the world, being 17,930 feet above the sea. Gradually working to the southeast, the explorer saw to the north a magnificent snowy range, with a lofty peak in longitude 83° and latitude 35°. After many weeks' travel over uplands exceeding 15,000 feet in height, where water was scarce and no inhabitants were to be seen, the party on September 3 reached Gya-Kin-Linchin, on the northern shore of Tengri Nor Lake, in longitude 91° and latitude 31°. This is within a few marches of Lhassa, and two officials from the Devi Jong, or temporal governor of Lhassa, met him here and peremptorily ordered him to go back. But he refused to return, and a compromise was effected, guides and ponies being provided on his agreeing to make a detour to the north in order to reach the frontier of Western China. He reached Chiamdo on December 31, only just succeeding in getting off the tableland before winter set in. He struck Bonvalot's route for a few miles when marching to Chiamdo. The country about this town is very fertile and well wooded. Three thousand of the monks of Chiamdo, who lived in fine monasteries, threatened to attack the party, but were deterred on learning that they carried breechloaders. Captain Bower arrived at Tarchindo, an outpost on the Chinese frontier, on February 10. The distance covered from Lanakma to Tarchindo was over 2,000 miles, all of which, save a few miles, has now been explored for the first time. The route for thirteen consecutive days lay over a tableland 17,000 feet high. Captain Bower is engaged in writing a report and completing his maps.

The Condensers of the Baltimore.

Recently on removing the tubes there was nothing in their appearance to indicate anything wrong, but it was found that a very light blow would break them across. The fracture showed a complete change in the material. A thin ring on the inside had the color and appearance of the brass of which the tubes were originally composed, but outside of this the rest of the tube was of a dull copper color without metallic luster. The whole phenomenon was so entirely different from the usual experience with condenser tubes, which have generally been considered indestructible when intelligently treated, that an explanation seems impossible. As far as can be learned, there has been trouble on nearly all the new ships with the copper pipes, and it is not confined to the American navy, but the English have had the same trouble. A correct explanation will be of great interest to all mechanical engineers. A chemical analysis of some of the defective tubes of the Baltimore is now in progress, and when it is completed it may throw some light on the subject.

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THE MAGNETIC STORM OF FEBRUARY 13, 1892.

BY S. J. BROWN AND J. A. HOOGEWERFF.

The facts which have led to the connection of disturbances on the sun with magnetic and electrical storms on the earth have been added to by the simultaneous occurrence, in February of this year, of these phenomena on the two bodies which, though separated by a distance of 92,000,000 miles, seem to be in close sympathetic connection.

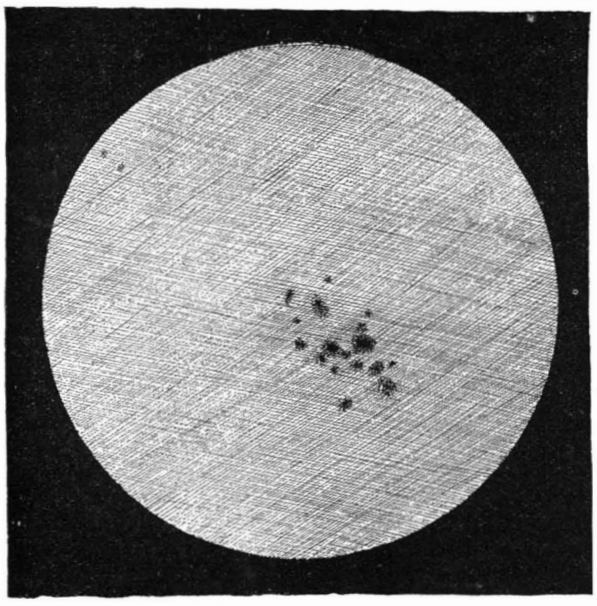

Fig. 1.—SUN SPOTS AS SEEN THROUGH THE 9·6 INCH EQUATORIAL AT THE NAVAL OBSERVATORY, FEBRUARY 13, 1891.

(Drawn from a photograph by J. A. Hoogewerff.)

On February 12 there was published in the papers throughout the country an announcement of the appearance of a large spot on the sun. Through a piece of glass smoked over the flame of a candle, so as to diminish the intensity of the sun's light, this spot appeared as a nearly circular black speck, which, though small, could be distinctly seen. The telescope resolved it into a group of spots of immense extent, covering an area of about 140,000 by 100,000 miles, which, roughly speaking, is 140 times the total area of the earth.

Following this outbreak on the sun there appeared on the morning and evening of February 13 magnificent displays of the aurora borealis, visible generally throughout the northern part of America and Europe, which were accompanied by more or less derangement of telegraphic communication. The morning aurora was not generally noticed, but, in the evening, shortly after sunset, the northwestern sky was so vividly illuminated by a rosy glow that it was at first mistaken for the reflection of a distant fire. The rapid changes in its appearance soon showed its true character. Pulsating beams of greenish white light shot through the red up into the sky, transforming its dull glow into the ever-changing beauty of an aurora. "And now the northern lights begin to burn, faintly at first, like sunbeams playing in the waters of the blue sea. Then a soft crimson glow tinges the heavens. There is a blush on the cheek of night. The colors come and go, and change from crimson to gold, from gold to crimson. The snow is stained with rosy light. Twofold from the zenith, east and west, flames a fiery sword; and a broad band passes athwart the heavens, like a summer sunset. Soft purple clouds come sailing over the sky, and through their vapory folds the winking stars shine white as silver."—Longfellow.

The superstitions which formerly regarded these and other unusual phenomena as signs of approaching calamity are nearly outgrown in this scientific age, yet they still tinge the impressions of one who sees them for the first time.

From the fact of the appearance of the spots and auroræ, evidences of a magnetic storm were confidently looked for; and, upon developing the photographic record at the U. S. Naval Observatory, these expectations were fully realized. The records show graphically the direction at any moment of magnets so suspended that their movements are determined by the changes in the direction and intensity of the earth's magnetic force.

The action of the earth on a magnet can be roughly explained by imagining that at its center is a magnet whose axis is slightly inclined to the axis of the earth. A magnet develops in the space around it lines of force, one of which may be briefly defined as being the path which a single free magnetic pole would follow after being placed in it and subjected to the influence of the magnet. It is practically impossible to get a single magnetic pole, as such poles always exist in pairs, and no matter into how small pieces we may break a magnet, each piece has two poles, which have opposite effects, the one attracting and the other repelling a given pole of any magnet which may be brought near them. As the amount of this attraction or repulsion is greater the less is the distance separating the poles between which it is exercised, the result is that when two magnets are placed near each other they will, when free to move, place themselves so that their unlike poles are together. In the case of the imaginary magnet at the center of the earth, and any magnet on its surface, the length of the magnet is so small, compared with its distance from the center of the earth, that its two poles are at practically the same distance from either magnetic pole of the earth; and the magnet, if free to move, simply turns so as to set itself in the direction of the line of force created by the earth at that particular place. In the figure representing the earth (Fig. 2) *n s* is the magnet at its center, and the dotted lines are the lines of force produced by it. A single free north magnetic pole, if placed at A and free to move, would take the path A W *s*, while a free magnet (having, of course, two poles) would place itself along this line of force. A number of magnets are represented by *n' s'*, and each shows roughly the position which would be taken at that part of the earth by a magnet hung from its center of gravity, but free to turn in any direction. If there were a number of magnets floating around in the air, each magnet would turn until its poles were in the line of force which passed through its center. It will be seen from the figure that the magnets, besides pointing in a north and south direction, all have, except near the equator, a dip toward the center of the earth, while at the poles they are vertical.

It must not be taken for granted that there is such a magnet at the earth's center, or that the existence of it there would account perfectly for all the known

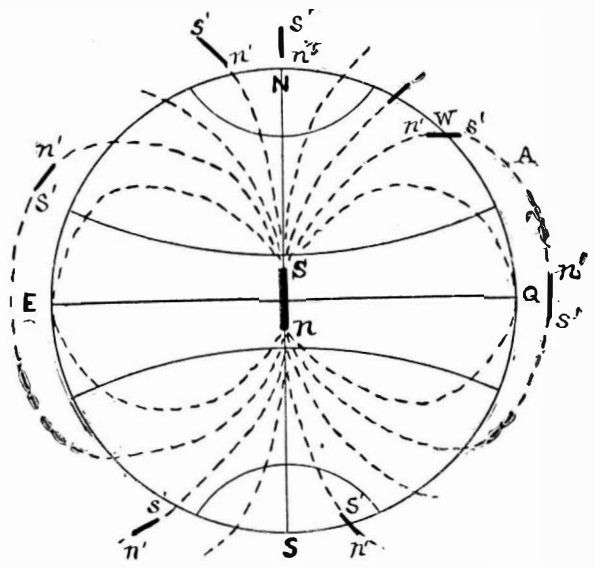

Fig. 2.—LINES OF FORCE PRODUCED BY THE EARTH CONSIDERED AS A MAGNET.

facts concerning the lines of force surrounding the earth; but it would simply account for there being such lines. As a matter of fact, the forces produced by a magnet may be duplicated by electric currents arranged in the proper way, and a system or systems of electric currents circulating in the earth and its surroundings can be imagined which will account very satisfactorily for the influence which we know to be exerted on magnetic needles at or near the earth's surface.

These lines of force which we know to exist are subject to changes both in direction and in amount of their influence on magnets.

The magnetic department at the U. S. Naval Observatory in Washington was established for the purpose of measuring and recording these changes. The apparatus (Figure 3) consists of three magnets, to each of which is fixed a small mirror from which a beam of light is reflected on to a strip of sensitive photographic paper placed on a revolving drum in a dark box. As long as the magnets remain stationary the revolution of the drums causes the light to make a straight line on the paper, but a motion of the magnet changes the line into an irregular one, the distance of which from the straight line shows the amount of the movement of the magnet. One of the three magnets is hung by a silk thread so as to be free to swing round in a horizontal plane. This magnet takes the horizontal direction of the lines of force, being practically a very sensitive compass. The second magnet is also horizontal, but is suspended by two platinum wires which are fastened to it a short distance apart. By turning the bar to which the upper ends of these wires are fastened, the magnet is twisted around until it points east and west, in which position it is most susceptible to the force which tends to make it point north and south. An increase in this force twists it one way, and a decrease of the force allows the wires to turn it slightly in the other direction. To appreciate the minuteness of this force one has but to turn a compass needle with his finger; and yet upon it depends

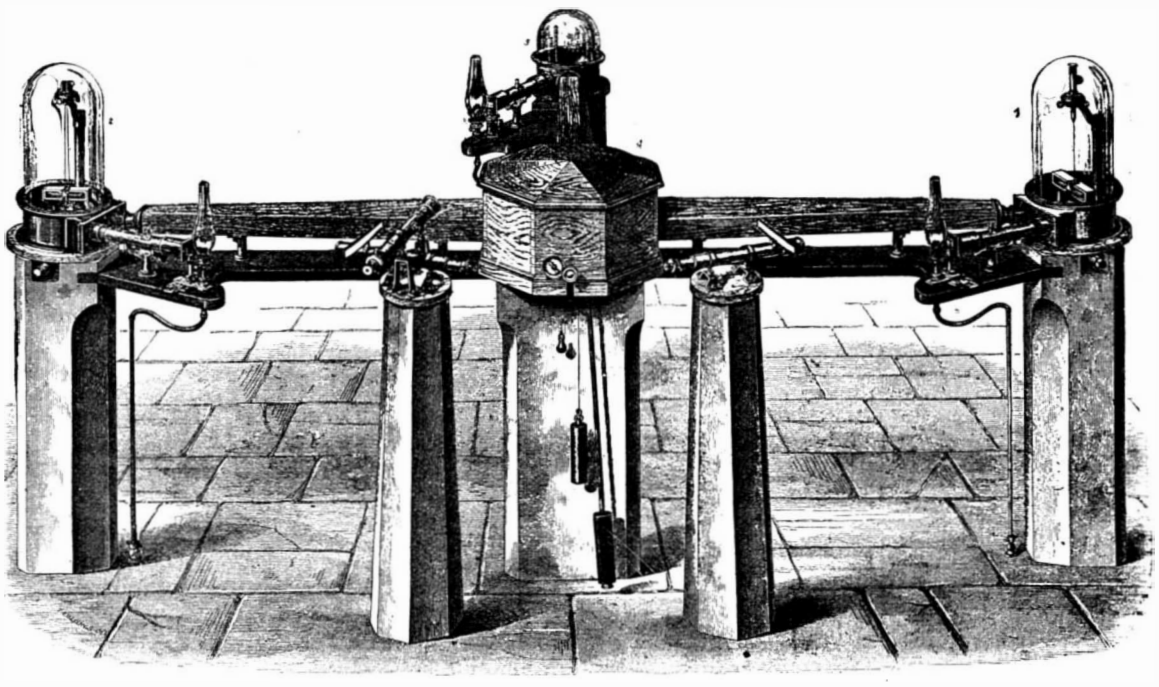

Fig. 3.—KEW MAGNETOGRAPH IN USE AT THE NAVAL OBSERVATORY, WASHINGTON.

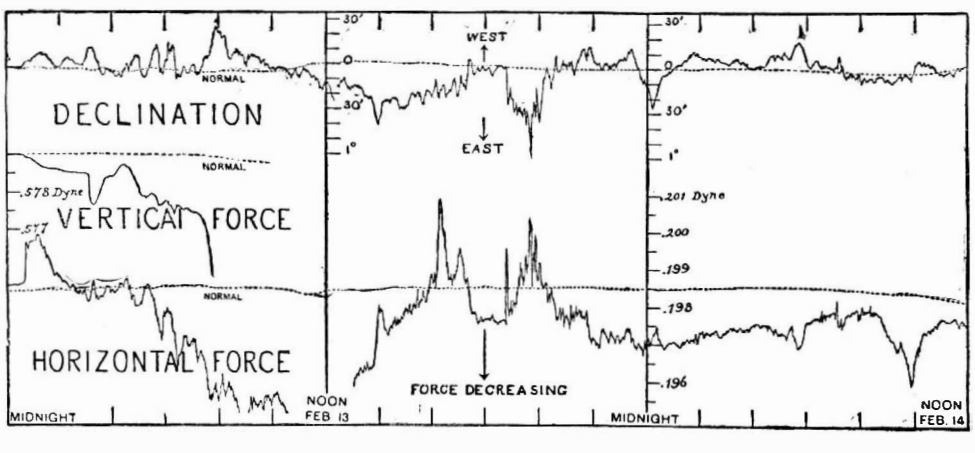

Fig. 4.—RECORD OF MAGNETIC STORM OF FEBRUARY 13-14, 1892.

(Taken at the U. S. Naval Observatory.)

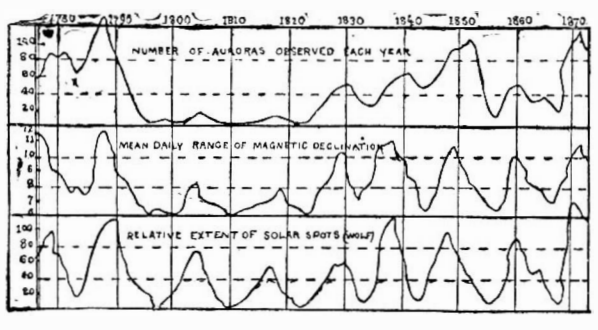

Fig. 5.—DIAGRAM SHOWING RELATION BETWEEN NUMBER OF AURORÆ, SUN SPOTS, AND MAGNETIC STORMS. (From Loomis' Chart.)

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the action of the compasses which have served for centuries to guide men over the trackless waters of the globe. The third magnet rests on a knife edge at its center, with a sufficient weight on its south end to keep it nearly horizontal. An increase in that part of the earth's force which acts vertically pulls the north end down a little, while a decrease in it allows the weight to force the other end down, just as though the magnet were the arms of a balance with varying weights put in the pans at either end. The three magnets being properly adjusted, from the records made by them the direction and total magnetic force of the earth at Washington can be found for any moment.

There are three principal changes which the earth's magnetic force at any place undergoes :

1. The direction in which it acts changes slowly from year to year, making a regular swing back and forth which it takes centuries to complete.

2. It has a regular daily variation which, though small, is perfectly well defined and capable of measurement.

3. There are intervals of time extending from a few minutes to several days during which its direction and force vary rapidly, attaining an amplitude much greater than during its daily or yearly changes. These variations are called magnetic storms.

The records of an unusually severe storm of this kind which occurred on February 13 are shown in the illustration, Fig. 4, which is an exact reduced copy of the photographic traces made by the magnets at the Naval Observatory. The upper line is the declination record, and shows the direction taken during the storm by the north end of the magnet, which is free to swing round in a horizontal plane. The lower line is the record of the magnet hung by two wires. It shows the change in the force exerted by the earth to make a compass or other horizontal magnetic needle point north and south. The break in the line near noon of the 13th is due to the disturbance having become so violent that the paper was not wide enough to show it. The middle line at the left is the record of the balanced magnet, and shows the changes in the earth's vertical magnetic force. This magnet was balanced so delicately that the unusual change in the force threw it completely from its balance at 8 A. M. of the 13th. The three broken lines are records made by the same magnets on an average day, and were taken on January 1 and 2 of this year. The record shows that the storm commenced suddenly, at 12:40 A. M., February 13, with a movement of the north end of the compass needle to the westward, accompanied by a rapid increase in the horizontal and decrease in the vertical magnetic force of the earth. The declination needle remained to the westward of its usual position until 10:30 A. M., when it crossed to the eastward, remaining there until 8 P. M., after which it kept oscillating about equally on each side of its normal position. The horizontal force, after its rapid increase, decreased by a series of oscillations (apparently endeavoring to stop at its normal strength) until about noon of the 13th, when it began to increase again in the same manner, attaining a maximum at 4:20 P. M. After very violent oscillations at about its mean value, it decreased at 8:20, keeping below its normal strength during the remainder of the storm. The vertical force continued its decrease until the balance of the needle was destroyed and farther record of it lost. The occurrence of the evening aurora, at 7:30 P. M., was marked by particularly violent and sudden oscillations of the magnets.

THE CONNECTION BETWEEN MAGNETIC STORMS AND OTHER PHENOMENA.

In 1857 attention was drawn to the fact that an increase in the frequency and violence of magnetic storms occurred at times when there were unusually large numbers of sunspots, and that the appearance of auroræ in great numbers was coincident with this increase. It is now apparent that these three phenomena increase in frequency and magnitude in cycles of about 11 years, and that the maxima and minima attained by each occur in the same years. This is illustrated by the diagram, which shows graphically the comparative number of auroræ, the amount of the daily change of direction of the magnetic declination, and the relative extent of solar spots for more than a hundred years. The similarity of the curves is too marked to be merely a coincidence, and discrepancies may be easily accounted for by the incompleteness, until late years, of the records of these phenomena. That the coincidence is not accidental has also been shown by numerous occurrences, one of which, witnessed by two well known astronomers, has become classic in the literature of the sun. On the 1st of September, 1859, there suddenly appeared within the area of a large group of spots two patches of intense white light which moved rapidly across the sun's disk. They faded away as suddenly as they had appeared, but, during their brief existence of five minutes, they had moved a distance of 35,000 miles. At the same instant the photographic instruments at Kew registered a marked disturbance of the magnetic elements. This event was preceded and followed by a magnetic storm of unusual intensity over the whole earth. Telegraphic communication was interrupted, magnetic instruments showed great oscillations, and magnificent auroræ were visible in both hemispheres, even at places near the equator where such phenomena are very rare. During 1882, a year of sunspot maximum, four similar occurrences were recorded, which, though differing in detail, were equally convincing.

Professor Young has observed similar effects in connection with solar prominences which were found to be accompanied by practically instantaneous disturbances of magnetic instruments and followed by fine auroræ.

What may be the nature of the connection between these phenomena is still a mystery, but it is probable that it will be found that they depend upon some common cause, which, originating in the sun, the source of all our energy, makes itself felt on the earth, through a distance of 92,000,000 miles, by means of vibrations in the ether which fills all space.

The enormous energy which can cause vast convulsions in the photosphere of the sun, and be transmitted through such a distance, is almost appalling, and yet what knowledge we can hope to get of it is through observations made with some of the most delicate instruments known to science.

Practical Notes on Lubricants.

The laws regulating lubrication, the action which the various articles used as lubricants have upon metals, and the chemical changes that are brought about by differences of temperature, have never received the consideration due them. Of late years, however, they have been treated more seriously by owners of machinery, and a writer in the *Boston Journal of Commerce* has compiled from various sources facts which users of machinery and engineers will find useful.

Competition among manufacturers to-day demands that the utmost caution be taken to reduce the wear and tear on the machinery, to avoid loss of time, and above all, to save fuel. In almost every case the correct use of proper oil will be found the precaution necessary.

A lubricant may apparently do good work and keep the part cool, but in reality the acid formed by the friction and heat of the journals is daily damaging the surface of the metal and will ultimately do great damage.

Consumers have for years been accustomed to rely upon the salesman, whose knowledge of the goods he sells is usually found to be very deficient. Nor can every engineer's report on an oil be relied upon ; many are really ignorant, while others are personally interested.

"Some months ago I engaged a salesman," says a writer in the *American Engineer*, "an active and intelligent engineer who professed to know something about oils, and whose general ideas about lubrication seemed sensible. Upon canvassing a part of the district allotted to him with good success, so far as he went, the firm received a letter from him, saying : 'I used to think I knew something about oil, but have come to the conclusion that my knowledge will not extend beyond the outside of the barrel.' This is what nine-tenths of the engineers would come to if their knowledge were put to a practical test.

"A good oil should be used as sparingly as the nature of the bearings will permit. The amount of resistance (friction) generated by the bearings depends upon the number of revolutions a minute a machine is capable of making and the amount of power necessary to run it. In the use of oil, uniformity of distribution is as important as the regularity of supply. A dry spot on a bearing will at once cause heating, and if allowed to continue, cutting will be the result.

"There is no department in a factory more important than the engine room. As the diminishing of friction will naturally result in gain of power, it is to the consumer's interest to learn by careful experiment the oils that are best adapted to run his plant, and to make the necessary tests of density, fire test and viscosity. By so doing he can be certain to receive exactly what his machine requires, and run it at the lowest possible cost.

"'Poor oils,' says an eminent engine builder, 'are a prolific source of injury, and often defeat the purpose for which a machine was intended.'

"If a machine is not properly lubricated it will bind, heat, and then cut, and the percentage of work added to the already overtaxed Corliss is sure to injure the engine, and certainly needs an extra dip now and then into the coal pile.

"No oil has been made that can economically lubricate all the journals of a mill. An oil running a heavy engine would not do to run a spindle or a fast-revolving dynamo. The former runs slowly and has great pressure and strain on its journals, and consequently requires an oil that will not spread too quickly, but with low gravity and high viscosity. The latter needs a pure mineral oil, viscous and quick-spreading, to enable it to enter into the closest parts of the bearing as rapidly as the speed at which it revolves necessitates.

"In making an oil for a specific purpose, the speed, power, pressure upon the journals, mode of application, and temperature at which it has to run should be known. This information in hand, an oil can be made to suit.

"The numerous tests that have been made by learned men at various times within the last twenty-five years tend to show that mineral lubricants, or compounds of mineral and animal, are the safest and produce the best results.

"Professor Thurston remarks: 'Vegetable and animal oils are compounds of glycerine with fatty acids. When they become old, decomposition takes place, acid is set free, and the oils become rancid. Rancid oil will attack and injure machinery. Mineral oil does not absorb oxygen, whether alone or in contact with cotton waste, and cannot, therefore, take fire spontaneously ; animal and vegetable oils do. Mineral lubricating oils are used on all kinds of machinery; they are the safest and cheapest lubricants, and are generally superior to animal and vegetable oils and greases.'

"According to experiments by Galletry and Coleman, it was found that 'mineral lubricating oils diffused through textile cotton do not take fire even at a temperature at which colza oil ignites, and that fatty lubricants to which 20 to 50 per cent of mineral oil was added were thereby prevented from igniting.'

"Spon says: 'A mineral oil flashing below 300° is unsafe. The best oil is that which has the greatest adhesion to metallic surfaces and the least cohesion in its own particles. In this respect fine mineral oils stand first. No oil is admissible which has been purified by means of mineral acids. Mixed oil, if properly compounded, possesses the special advantages of both classes.'

"The blending of mineral and animal oils does not merely consist in shaking them together, as is supposed by many, but as they are of different gravity, the globules of each must be broken and run into each other by agitation and heat, so that the oil will become one body. If this is not done, the animal oil will become separated, and standing in a heated room, the bad qualities will become manifest, and later, when used, the oil cannot do its work, and at once the quality is condemned.

"I had a case where a large mill owner was using oil said to be one part sperm and three parts paraffine, of heavy gravity. The price was lower than I knew it could be made for. Upon analyzing a sample drawn from the barrel I found it contained 60 per cent of sperm and 40 per cent of paraffine, showing that the oil was separating. The sperm oil being lighter was coming to the top. Such oils cannot give satisfactory results.

"If you have any stipulated formula, have it made up for you by people who understand the business, and who have the facilities and appliances for doing it properly.

"Mr. Allen's experiments have shown that gumming is due to the action of free acid upon the metal bearings of machinery.

"The corrosion of bearings by oils has not received the attention it deserves, as the wear and tear of the metals and thickening of the oils has been attributed to other causes. Liquid oils corrode metals very evenly, so that the effect is not readily observed. Mineral oils contain no acid, unless they have been carelessly refined.

"I. J. Redwood says: 'Mineral lubricating oil has the least action on metals; none on iron or brass. Tallow oil has most action on iron; castor, olive and lard oils have most action on brass. Rapeseed has most action on copper.'"

The Land and Water of the Globe.

Mr. John Murray, a member of the Challenger expedition, and one of the highest living authorities on oceanography, has recently been delivering some lectures in Boston of peculiar interest to scientific men and students. Among many special papers of great value which have been published by Mr. Murray is one relating to "The Height of the Land and the Depth of the Ocean." In this learned monograph it is estimated that the area of the dry land of the globe is 55,000,000 square miles and the area of the ocean 137,200,000 square miles. He estimates the volume of the dry land above the level of the sea at 23,450,000 cubic miles and the volume of the waters of the ocean at 323,800,000 cubic miles. He fixes the mean height of the land above the sea at 2,250 feet and the mean depth of the whole ocean at 12,480 feet. Of course these results are only approximate, but they help to render our ideas of these matters more definite.

In his paper Mr. Murray also estimates that the rivers of the world carry into the ocean every year 2½ cubic miles of sediment. To this must be added the matter carried to the sea in solution, which is estimated at 1·183 miles of matter. Together, then, the amount of matter carried through the land each year is 3·7 cubic miles. It would thus, according to this calculation, take 6,340,000 years to transport the whole of the solid land down to the sea.

THE average daily earning of an American locomotive is about $100.

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IRON AND STEEL IN LARGE BUILDINGS.

Out first page picture affords a vivid representation of the manner in which large, high buildings, in all the principal cities, are now erected. The contrast it presents to the old method of building, with wooden posts, beams, joists and stringers, the structure all supported by the walls, is very great. The revolution in building construction which this change represents may be said to have commenced about 1850. In 1845 Peter Cooper erected the largest rolling mill at that time in the United States, for making railroad iron, and at this mill he was the first, soon afterward, to roll wrought iron beams for fireproof buildings. In the building of the Cooper Institute in New York City, in 1857, he was the first to employ such beams with brick arches to support the floors, in a large structure designed to be fireproof. In this building, however, as in all similar structures up to a very recent period, the walls were depended upon to furnish the principal support of the several floors and give the necessary strength and stability to the building. Such dependence upon the walls alone has been found to be increasingly difficult and vastly more expensive with every addition to the height of the building; and where it was necessary to make the walls, at the first story, four or five feet or more thick, as has often been the case in eight or nine story buildings, a large proportion of the most valuable room was thus taken up. The modern method of building obviates this difficulty, and enables the architect to put up structures twenty or more stories high having every desired element of strength and stability, but with the walls forming only a mere shell inclosing the building, and in no way depended upon for its support. This is accomplished by making a good foundation for each of the iron columns of the interior, the weight of the structure in all its parts being carefully figured out, with due allowance for the uses to which the building is to be put, and the several foundations for interior pillars, columns, and piers being prepared in accordance with the manner in which the weight and strains of the completed building will be distributed. In this way of building the walls are only intended to support their own weight, serving such purposes of ornamentation or embellishment as may be sought, the openings for the admission of light and air to the interior being largely increased, or, as has been followed in some cases, the exterior may be formed almost entirely of glass.

The building in course of construction shown on our first page gives a good idea of this modern method of putting up great business and office edifices. It is the H. C. Brown Palace Hotel in Denver, Col., designed to be ready for occupancy this summer. It is triangular in ground plan, the measurements on the three sides being 230, 231 and 326 feet respectively, and the corners of the triangle being rounded. It is nine stories high, with a basement 18 feet deep extending to the outer limits of the sidewalk, while the highest part of the cornice is 131 feet above the sidewalk. The building is of the Italian renaissance style, and Messrs. F. E. Edbrooke & Co., the architects, have personally superintended the construction in all particulars, the work requiring nearly three years. It is said that the drawings required nearly two tons of paper.

The first story is of Platte Cañon pink granite up to the second story sills, all facing above being of Arizona brownstone. There is a series of arches in the seventh story spanning 12 feet between piers, and under the arches is a very rich carved cornice 3 feet high extending entirely around the building. The cornice is moulded with dentils and carving, forming a very beautiful and dignified finish. Over the main entrance is a series of projecting bays supported by cantilever beams. The entrances are spanned with elliptical arches beautifully carved throughout. The entire building is well decorated with relief carving costing about $40,000.

The backing of the walls from the second to the fourth floors is extra-hard flagstone from the vicinity of Fort Collins, Col. Above the fourth floor the walls are backed with pressed brick, manufactured at Golden, Col. The piers in the basement under the granite piers are built of dimension flagstone, 16 inches thick. These piers are 5 by 6 feet, with flagstone footings and concrete bed. The concrete was made of Denver Portland cement, which has proved where it has been unearthed to be very hard and satisfactory in every respect. The granite piers in the first story are 4 feet square, battered 6 inches on the face. The piers from the second to the fourth floors are 3 feet 4 inches by 8 feet. The piers above the fourth floor are 3 feet by 8 feet. There are over 100,000 cubic feet of masonry in the building exclusive of the fire-proofing.

The construction of the interior is upon cast iron columns and steel beams arranged to receive the tile arches. The general spacing of columns is between 20 and 21 feet apart. The principal floor beams are 12 inches deep, and the cross girders are 15 inches deep.

There is an interior court fifty-six feet square in the center of the building. On the first floor under this open court is the hotel lobby. At the third floor is a 27 inch box girder for the purpose of carrying a solid wall to the top of the building in case it should be desired, in which case there will be a skylight at the third floor closing over this court. At present, however, the building will be finished with the entire court separated from the upper corridors only by a four-foot bronze-plated railing.

The court is covered with a flat ceiling of stained glass and plated iron ribs suspended at the ninth floor. Above this is a skylight covering the entire court supported by steel trusses. The kitchen and grand dining rooms are on the eighth floor. The main grand dining room is 110 feet by 36 feet. The ladies ordinary is 80 feet by 36 feet. These dining rooms have 18 foot ceilings, spanned by 24 inch steel beams and box girders.

The false ceilings under the roof are constructed with T irons suspended from roof, filled in with fireproofing. The roof is constructed of I beams and T irons filled in with fireproofing. The total amount of iron and steel used in the construction of the building is over 2,500 tons. The first and second stories of iron were constructed by the Colorado Iron Works, and the remainder was constructed by the Lane Bridge and Iron Works. The fireproofing comprises all floors, arches, concreting, and all partitions. The arches are about 6 foot span, except in some cases, which are as great as 8 feet. The depth of the arch used is 10 inches. There is 4½ inches of concrete and cement above the floor arch. The finished floor is unglazed tile throughout the building, except in the chambers, where it is cement. The partitions are all built of 4 inch tile except the partitions around the grand dining rooms and the penthouses on the roof, which are 6 inch tile. All tile partitions exposed to the weather are plastered with a heavy coat of cement, blocked off to imitate stone. All inside partitions are plastered with Acme cement.

The total amount of fireproof tile and concrete used in the building is over 350,000 cubic feet.

In the building there are six hydraulic elevators, four Corliss engines, four boilers, six dynamos, 90,000 feet of electric light wire, 4,200 incandescent lights and 88 arc lights, five electric motors, seven ventilating fans, a large steam laundry, an ice manufacturing plant, two bakeries, a crematory, 160 tile mantels, 142 bath and toilet rooms, in which there are 13 car loads of plumbing fixtures, and 75,000 lb. of ornamental iron copper-bronze plated.

All the wood finish throughout the building is hard wood. The stairways are marble. The wainscoting and finish in the rotunda, all corridors, the cafe, the grand dining rooms, and the grand drawing rooms are real oynx.

There are 318 chambers above the first floor, all opening on the street fronts, with not less than two windows each; there are 18 large stores on the first floor besides all necessary room for the hotel, cafe, bar, private offices, etc. The cost of the building is $1,250,000.

The New Gunboat Castine.

This latest addition to our new navy, launched at Bath, Me., May 11, is a twin vessel to the Machias, built at the same place, and illustrated in the SCIENTIFIC AMERICAN of December 19 last. The launch was in every way a great success and witnessed by numerous officials and a vast number of people. Work upon the vessel was begun in 1890, and it is expected she will be completed in November next. She is a twin screw steel gunboat of 1,050 tons displacement. She measures 190 ft. in length and has a beam of 32 ft. When coaled and provisioned for sea, she will have a mean draught of 12 feet. She is 160 tons larger than the Petrel, the first of this class which was launched, and her tonnage exceeds that of the recently completed practice cruiser Bancroft by 212 tons. Her twin screws are revolved by vertical triple expansion engines inclosed in a water-tight compartment. She is expected to show an indicated horse power of 1,600, and to develop a speed of 14 knots an hour. Her radius of action at 10 knots speed is 4,668, and 2,452 miles at her maximum speed. She will carry a crew of 150 men. The Castine will mount a very effective battery for a vessel of her class. The main armament will comprise eight four-inch rapid-firing guns. The secondary battery will consist of two 47 mm. revolving cannon, two 37 mm. revolving cannon, one one-pounder rapid-fire, and one Gatling.

In several respects the Castine and her sister ship will be peculiarly well adapted for service in Asiatic and South American waters. Their slight draught will enable them to ascend the rivers where vessels of deeper draught could not navigate. Their batteries are heavy enough for any service they are likely to be called upon to perform, and the effectiveness of the four-inch gun on its rapid-fire mount has been recently demonstrated by the Bureau of Ordnance trials. The rig of the Castine will be that of a two-masted schooner with a square sail on the fore. She will spread 6,506 ft. of canvas, which will be sufficient to enable her to make her way to port should her machinery be disabled at sea.

Correspondence.

Permanence of Water in a Bored Well.

To the Editor of the Scientific American:

A manufacturing concern using about 10,000 gallons of water a day have bored a well on their plant 115 feet deep and have struck nice, clear, and suitable water, drawn up by a pump and a 100 foot plunger, 2 inch pipe. The water rises 2½ to 3 feet above the ground without the pump. Sometimes, when starting in the morning, the water is cloudy, but soon clear again. There can be pumped 8,000 gallons in ten hours now. The concern has been getting water from a river about one third of a mile distant, but wishes to be independent of it, as the pipes, ground, and pump station are not their property. Is there any chance of this water giving out, or what are the prospects for permanency in depending upon this well; and can you advise anything to increase or protect the flow? A reservoir to hold about 200,000 gallons of water is contemplated to be built.

We are situated about 80 to 90 feet above Lake Michigan, about 10 miles west of it, and one-half mile west of the Desplaines River. Our well is 115 feet deep, the soil is clay to about within 3 feet of the water, then follows 1 foot of cemented gravel, then 18 inches of very coarse gravel, in which we found the water, and below the water cemented gravel again. The well has a steady, natural flow of about 800 gallons in 24 hours.

In the meantime we have followed your advice of increasing and utilizing all possible pumping facilities, and are well supplied with plenty of water at present.

P. K.

[The indications as described are most favorable for a large and permanent supply of water to the extent of your pumping capacity. The only possible obstruction that could occur will be from gravel coming into the pipe, which can be soon cleared by the boring tools. We have no record of failure from an artesian well drawing its water from a coarse gravel bed under a thick clay bed. The gravel bed in which your well terminates probably outcrops to the north and west, toward the Wisconsin line, and where the country is somewhat higher than at your place. Your well seems to be in a geological water basin, that is shut off from Lake Michigan by the outcrop of the Silurian limestone between the lake shore and the Desplaines River, having its drainage to the south through the Desplaines River, and deriving its water supply from the ridge land to the north and west.—EDITOR.]

A New Steel Bridge Over the Mississippi.

ON the 12th of May a great steel bridge over the Mississippi River, at Memphis, was formally opened for traffic, amid appropriate festivities and with not a little public rejoicing. It was built by the Kansas City, Memphis & Birmingham Railroad Co. It is situated on the spot where Ferdinand De Soto crossed the Mississippi in 1541, and in excavating for the shore pier on the Tennessee side some Spanish halberds, supposed to have been used by him, were found. The bridge is the third largest of its kind in the world. Active work upon it began in the fall of 1888, when the first caissons were sunk. There are five spans and six piers, including the anchorage pier. The east shore, or cantilever, span is 225·83 ft.; the main span, consisting of two cantilever arms and one intermediate span, is 794·42 ft.; one continuous span, 621·06 ft.; one deck span, 338·75 ft. The total length of the bridge is 2,597·12 ft. The structure is extended west of the main bridge by an iron viaduct 2,500 ft. in length, followed by a 3,100 ft. timber trestle, and nearly a mile of embankment to a junction with the existing track of the Kansas City, Fort Scott & Memphis Railroad, a few hundred feet west of Sibley, Ark. The river piers are sunk to depths varying from 75 to 131 ft. below high-water mark. All were sunk by the pneumatic caisson process, and are of masonry from the caissons to the bridge seats. The material of the main bridge is steel. The main posts are 80 ft. high and weigh 28 tons. Many of the pieces weigh 10, 12, and 16 tons. The main pin of the cantilever truss is 14 in. in diameter, and weighs 2,200 pounds.

A Railway Ferry Across Lake Michigan.

The bold idea of ferrying loaded freight cars across Lake Michigan is soon to be put into practice. A large propeller is under construction at Toledo which will have a capacity of 21 cars, and it is expected to tow a barge carrying 15 cars, making 36 cars, or more than an average freight train. The cost of transferring grain and other freight from cars to steamer and from steamer to cars forms a very heavy item of cost which the proposed plan, if successful, will save. Lake Michigan, however, is a treacherous water and considerable risk will be involved in ferrying cars across it, especially in winter when ice abounds. The new boats are to ply between Frankfort, on the Michigan shore, and Kewaunee, on the Wisconsin shore, a distance of 52 miles, connecting the Toledo, Ann Arbor & Northern with the Green Bay, Winona & St. Paul Railway. —*Railway Age.*

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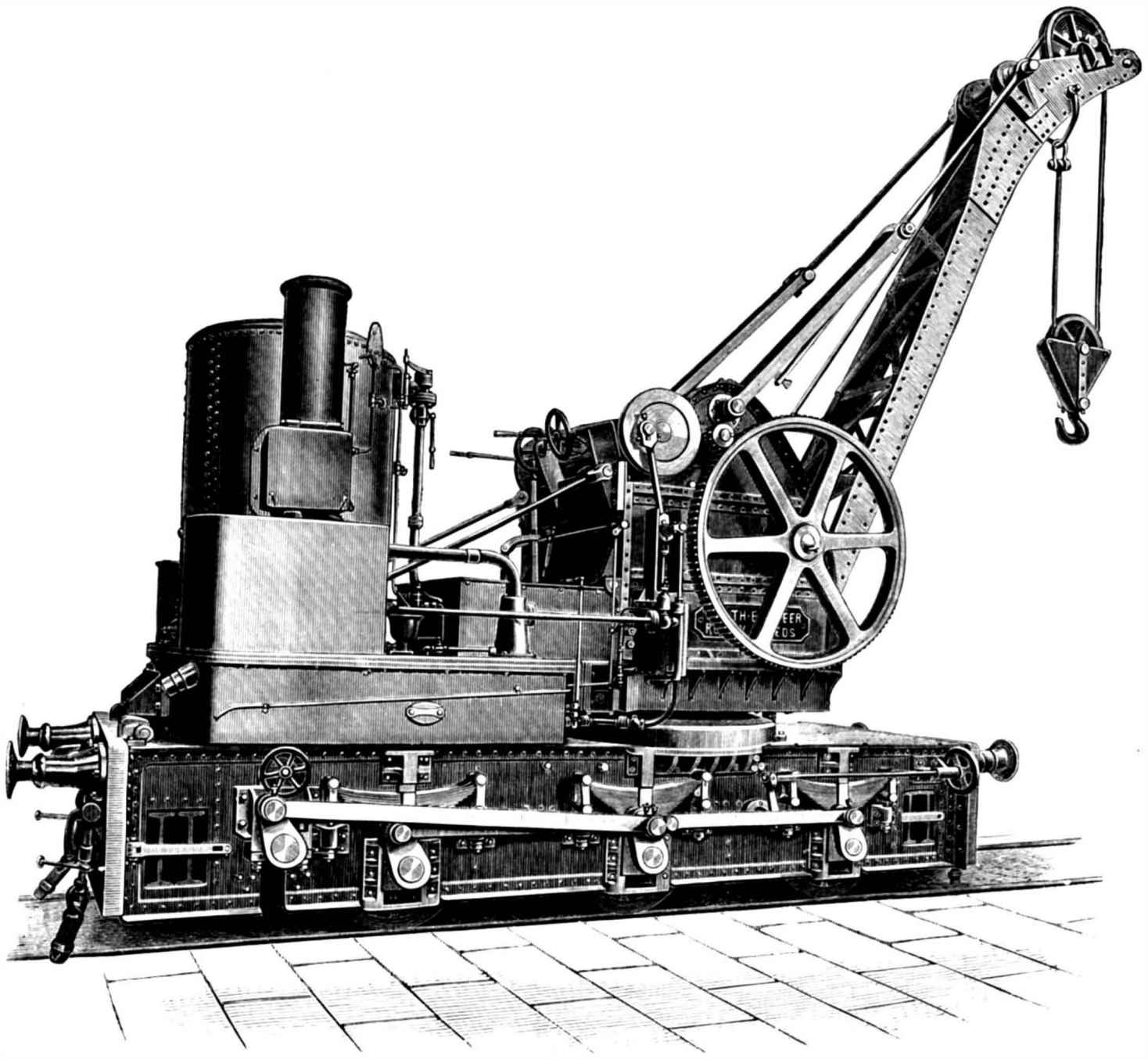
IMPROVED LOCOMOTIVE STEAM CRANE.

The engraving represents a general view of a 16 ton locomotive steam permanent way traveling crane constructed by Mr. T. Smith, of Rodley, near Leeds, for which we are indebted to *Industries*. The engines for operating the crane consist of a pair of the vertical type, with cylinders 8½ inches diameter and 12 inch stroke. These receive steam from a "Nicholson" type of boiler, 7 feet 6 inches high and 4 feet 6 inches diameter, low built, with a large combustion chamber over the fire box, and Galloway tubes. The boiler has been tested hydraulically up to 150 pounds, and by steam up to between 75 pounds and 80 pounds per square inch. The jib is constructed on the lattice principle, with a curved head to allow of heavy loads being dealt with. The crab sides are of mild steel plates, and are firmly secured to the top and bottom swivels. The latter have anti-friction rollers for running on a turned path to reduce the stress caused by the load on the central column. The hoisting motion is of double purchase spur gearing, controlled by a clutch and lever and powerful friction brake. A feed pump, injector and tank are provided for supplying the feed water. The carriage is propelled by bevel wheels gearing with the engine shaft by means of spur and miter wheels, and driving the transverse shaft under the carriage, on which there are two cranks connected up by coupling rods and cranks to the traveling wheels of the crane. The frame of the latter is of mild steel plates and angles, and is mounted on six traveling wheels 3 feet diameter, with cast iron centers and steel tires shrunk and riveted on, and the axles are of steel. The whole superstructure radiates on a strong steel central pillar, accurately fitting a massive cast iron base plate, turned on the top to carry the roller path and internal wheel for revolving the crane. The various parts are easy of access for adjustment and similar purposes, and the whole of the movements are within easy reach and control of one attendant. The total weight of the crane is about 50 tons.



IMPROVED LOCOMOTIVE STEAM CRANE.

A Plant-feeding Ladybird.

Professor C. V. Riley, at a recent meeting of the Washington Entomological Society, gave some notes on the life-habits of our common spotted ladybird (*Megilla maculata*). He gave descriptions of the egg and larva, which have hitherto never been described or figured, and also a *resume* of the habits of the insect. The larva, he stated, was altogether entomophagous, as far as known, while the adults feed largely on vegetable material and also to some extent on soft-bodied insects, approaching more nearly in their food habits the genus Epilachna. He stated that the beetles are known to feed on the pollen of plants, to injure blades of corn, and also the soft kernels of corn, wheat blossoms, and the larvæ and pupæ of *Lina scripta*, the larvæ of *Diplosis tritici*, and other soft insects.

No Right to Tax Patent Rights.

A case has just been decided in Pittsburg which is of importance to electrical manufacturers. Although it has reference to Pennsylvania State laws, it nevertheless has some bearing in the other States as well, as it appears to be a question of interfering with rights granted by Congress. The question was whether the State had the right to tax the Westinghouse Company. The tax law exempts companies organized exclusively for manufacturing purposes, but the officers of the State claimed that the company has in its charter a great variety of powers besides those belonging strictly to a manufacturing corporation, and was therefore taxed upon its whole capital stock. The company claimed that its sole business was the manufacture of electrical apparatus. Regarding this point, Judge McPherson decided that the company, notwithstanding the varied powers conferred by its charter, was nevertheless organized exclusively for manufacturing purposes, which decision seems to be eminently just. The company has other powers than those of manufacturing conferred by its charter, but it does not use them. The question also came up as to the right to be taxed for stock invested in patents. A large part of the capital stock of that company is invested in this manner, and it claims that this cannot lawfully be taxed by the State in any event. The court sustained the contention of the company's counsel, and held that the right to tax patent rights does not exist in the State: "as a tax upon the right itself we think it cannot possibly be supported because it restricts and interferes with a right granted by Congress in the exercise of the power committed to the government of the United States by the Federal Constitution. The tax is not only derogatory from the dignity, but subversive of the powers of the government and repugnant to its paramount sovereignty." The court expressly states, however, that the opinion is restricted to the intangible rights existing in the patents, and does not extend to tangible articles manufactured under patent rights. The decision in each of the cases was entirely in favor of the company.—*The Electrical World.*

Natural Gas and Oil Fuel.

The water works at Detroit, Mich., have for some months been using natural gas for fuel at the pumping station, the gas being furnished for the amount it would cost to do the same work with hard coal. In December, 1891, the total amount of gas consumed was 12,366,000 cubic feet, for which the city paid about 22 cents per 1,000 cubic feet. The cost of gas is, therefore, no more economical than that of coal, and while the gas is preferable for some reasons, it is objectionable for others. It has therefore been determined to use crude oil, brought by rail in tank cars to within two miles of the pumping station, a pipe line being erected for that distance. A ton of hard coal is taken as equal to 168 gallons of oil. In 1890 there were 7,616 tons of hard coal used to pump 12,121,000,000 gallons of water, or 1 ton to 1,854,130 gallons, and the cost of coal was $31,763. Taking 1,279,488 gallons of oil as equal to 7,616 tons of coal, and cost $1.20 per 100 gallons, the cost for fuel would be $16,406, minus $1,620 in saving of labor, and plus $3,000 for conveying from railway to works, or $17,786 total cost for oil, against $31,763 for coal, a saving of $13,977, or 44 per cent. Crude oil for fuel is also to be tried at one of the water works pumping stations at Minneapolis, Minn. The specifications for boiler plant for the World's Columbian Exposition provide for the use of oil fuel, to avoid the smoke from coal. This boiler plant is to have 100,000 square feet of heating surface, and to evaporate 450,000 pounds of water per hour at a gauge pressure of 125 pounds per square inch.

AN aluminum launch, the motor of which is a naphtha engine, has been constructed by Messrs. Escher, Wyss & Co., of Zurich. The exterior of the vessel is for the most part polished, and the consequent smoothness gives the craft a considerably greater speed than could be obtained from a steel or wooden launch of the same dimensions and engine power. The saving of weight is also important. Only the mere hull of the new craft is of aluminum, yet the utilization of this metal renders the boat 35 per cent lighter than an ordinary launch of the same size would be.

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AN ELECTRIC CHIME.

Notwithstanding the fact that much of the music produced by chimes is rendered with discords and a clangor little less than barbarous, most people like this sort of music and are ever ready to listen to it. Possibly one reason for this is that this music is not so common as other kinds; another is that there is a kind of unwritten poetry about bells that appeals to everybody.

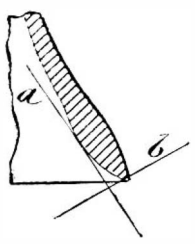

Fig. 1.

Tower chimes are for the public, and rich and poor alike can enjoy them, but smaller chimes are mainly for those who are able to purchase them, in fact, they may be classed among luxuries. However, house clock chimes bring bell music out of the list of the extraordinary and place it within the range of every-day home life. There is no reason why any one with a mechanical turn of mind cannot construct a chime without much expense. All that is needed is a lathe, a few tools and eight or ten ordinary hand bells. The bells are to be tuned so that when struck they will yield the notes of the diatonic scale. Tuning is a comparatively simple matter. If the workman does not happen to have a musical ear, he can procure the assistance of some one who has.

A fine bell made of genuine bell metal is one thing, and the ordinary hand bell sold at the hardware and house furnishing goods stores is quite another thing, still the latter afford the most available material for a chime, and withal answer a very good purpose.

The writer had the good fortune to find a dealer who was kind enough to allow him to select from a large number eight bells having approximately the required pitch for an octave, and two additional bells, one above and the other below the octave. These bells first of all had to be tuned to render them useful in a chime. This, although a simple operation mechanically, requires some skill in determining the pitch, as an ordinary bell generally yields two or more discordant notes.

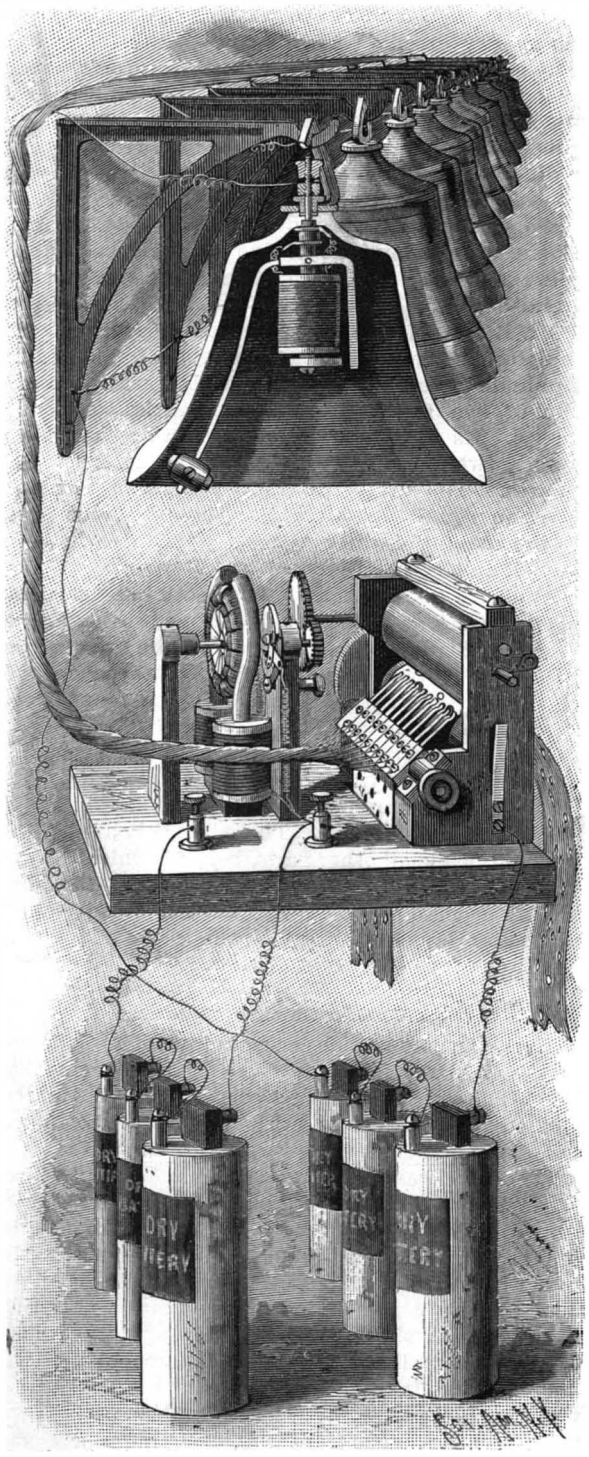

Fig. 2.—ARRANGEMENT OF THE BELL CIRCUIT.

The bell to be tuned is chucked on the lathe by means of a concave wooden chuck secured to the face plate. If the lathe has a hollow mandrel, the bell may be held in place by a long bolt extending through the bell and lathe mandrel. After the bell is centered, so that its rim runs true, a block is fitted to it at a point within the thicker portion of the rim and held in place by the tail stock of the lathe. This prevents vibration and the chattering of the tool; an ordinary hand brass-turning tool is used. If the pitch of the bell is too high, and it is required to lower it, the thick part of the rim is turned off on the line, *a*, as shown in Fig. 1. If, on the other hand, the pitch is too low, it is raised by turning off the edge of the rim on the line, *b*. Whenever it is desired to test the note of the bell, the block is removed and the bell is struck with a small wooden mallet. The note can be compared with that of a piano or other musical instrument, or the proper pitch can be arrived at by comparing the bells with each other. It is scarcely practicable to tune the chime to any particular key unless the majority of the bells are near the required pitch at the start.

After the bells are tuned they are each provided with an electric bell hammer, as shown in the first bell of the series in the upper part of Fig. 2. As this bell hammer is almost identical with that of an electric bell of comparatively recent invention, the writer in justice to himself must say that this electric bell was devised by him long before the bell alluded to was known to the public.

The magnet core is reduced in diameter at its upper end and extends through the aperture at the top of the bell and is threaded to receive two nuts, between which a wire is clamped. These wires from the several bells are connected with the contact springs or keys of the current-controlling mechanism shown at the center of Fig. 2. The core is insulated from the bell, and between the lower nut and the bell is clamped a yoke or loop which is in electrical contact with the bell, but insulated from the core. On the core is placed a bobbin wound with No. 24 wire. To the lower end of core is attached a pole extension, which reaches beyond the periphery of the bobbin and is provided with a short copper stud to prevent the sticking of the armature. To the core above the bobbin is pivoted the armature which extends downward over the side of the bobbin to a point opposite the pole extension. The armature is prolonged beyond its pivot and drilled to receive the hammer wire, which extends downwardly toward the mouth of the bell and carries a hollow metal hammer containing a wooden plug. The hammer is arranged to strike on the thicker portion of the bell rim. One terminal of the bobbin is connected with the magnet core, the other with the bell; each bell is supported by a bracket, the end of which enters the yoke or loop.

The brackets are connected together electrically and communicate through a wire with one pole of the battery, the other pole of which is connected with a spring which presses on the shaft of the metallic drum of the current-distributing machine. The springs before alluded to press on the cylinder through perforations in a strip of paper on which is arranged the music to be played. The springs are attached to a bar which may be turned back so as to remove the springs from the paper strip and the drum to facilitate the introduction of a new paper strip. Above the drum is placed a wooden roller, the gudgeons of which are pressed downward by springs—the roller being designed to insure sufficient friction of the paper to carry it with a positive motion through the machine. A worm wheel secured to the shaft of the metal drum is driven by a worm on a shaft extending at right angles to the drum and carrying a spur wheel which receives its motion from a pinion on the shaft of the electric motor. The motor is of the kind described in SUPPLEMENT, 783, and will therefore require no detailed description here.

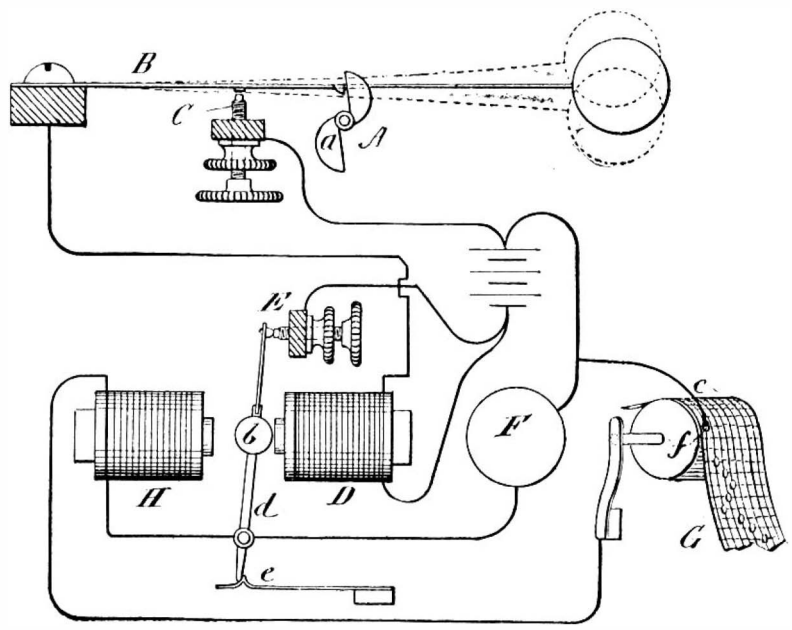

Fig. 4.—LET-OFF MECHANISM.

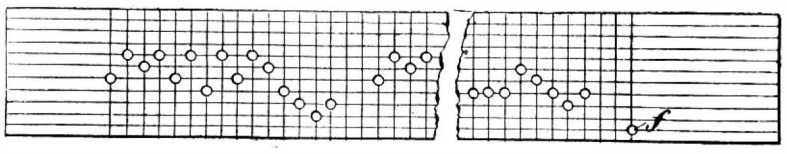

Fig. 5.—THE MUSIC.

When the electric chime is connected with a clock, as shown in Fig. 2, it is necessary to provide a very long perforated paper strip or to employ a perforated endless paper belt, and to provide means for starting the motor at the proper time and stopping it when the piece is finished. The mechanism for doing this is shown diagrammatically in Fig. 4. In this case the let-off mechanism is arranged to operate every half hour, but, of course, it could be made so as to operate every quarter hour.

On the minute hand arbor are secured two cams, *a*, and to the frame of the clock is secured the spring arm, B, furnished with a triangular arm projecting into the path of the cams, *a*. The free end of the spring arm carries a weight, and in an insulating bar, placed between the arbor, A, and support of the spring arm, B, is inserted a contact screw, C. The spring arm, B, is held normally out of contact with the contact screw, C. When the arm, B, is raised by one of the cams, *a*, and released, the momentum of the weight attached to the free end of the arm carries the arm beyond its normal position and momentarily closes the circuit on the contact screw, C. The electrical con-

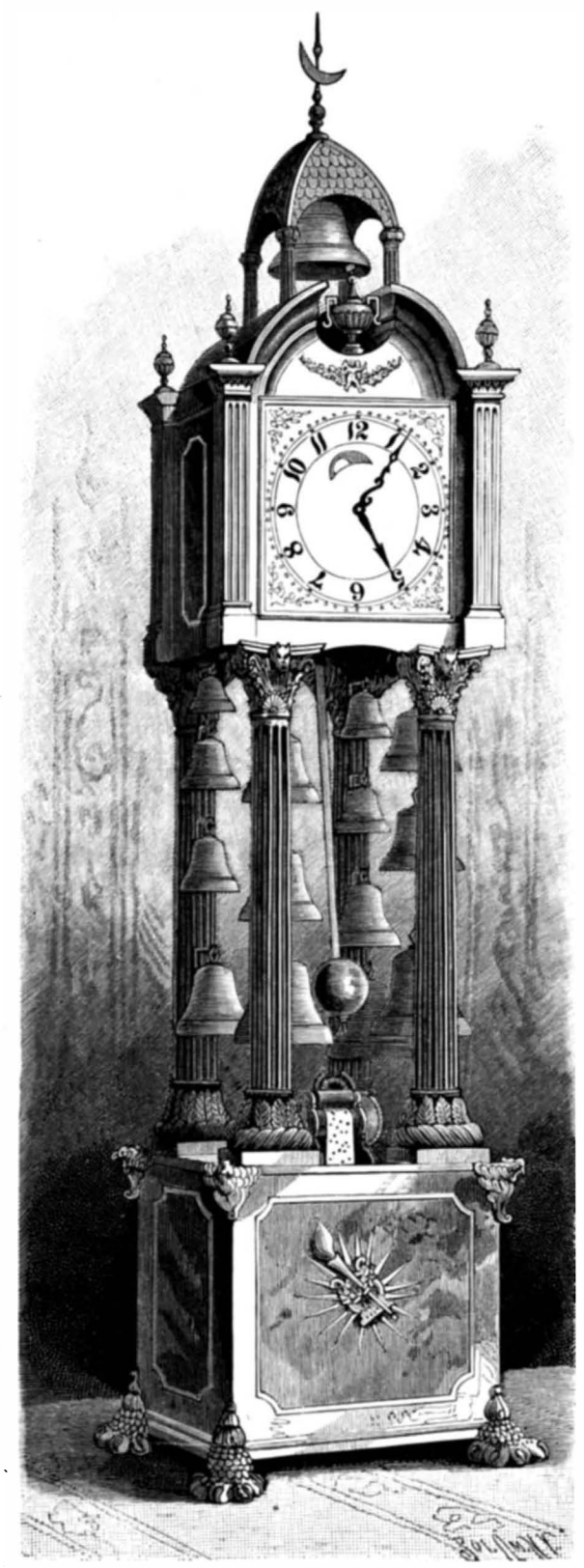
Fig. 3.—CLOCK WITH ELECTRIC CHIME.

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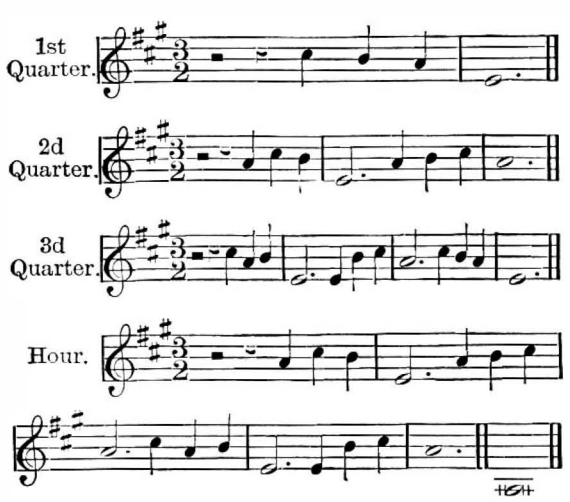
tact is prolonged by virtue of the momentum of the weight and the bending of the spring arm.

The contact screw, C, is connected with one pole of the battery, and the remaining pole is connected with one terminal of the magnet, D, the other terminal being connected with the spring arm, B. The contact screw, E, is connected with the battery in parallel with the magnet, D, and a wire running from the battery is connected in parallel with the wire leading to the contact screw, C. This wire connects with the motor, F, which drives the paper-carrying drum, and also with the auxiliary contact spring, *c*. The paper strip has a single perforation, *f*, located at the end of the piece of music, through which the spring, *c*, may touch the cylinder. The armature lever, *d*, is pivoted midway between the magnets, H D, and it is held in either of the two positions it may assume by the double-acting spring, *e*.

When one of the cams, *a*, raises the spring arm, B, and allows it to fall, the current from the battery is momentarily sent through the magnet, D, thereby drawing over the armature, *b*, and bringing the contact spring carried by the armature lever into contact with the screw, E; and although the magnet, D, ceases to act when this is done, the spring remains in contact with the screw and the current flows from the battery to the screw, E, thence through the armature lever to the motor, F, and from the motor back to the battery. This starts the motor of the current-distributing mechanism, and the current is sent to the one or the other of the bells, according to the position of the holes in the paper strip.

When the end of the piece is reached, the spring, *c*, forms an electrical contact with the metallic drum through the hole, *f*, in the paper strip, G. The current from the battery then flows through the screw, P, and armature lever, *d*, to the magnet, H (whose resistance is somewhat less than that of the motor), thence through the metallic drum back to the battery. The armature, *b*, is thus drawn over to the magnet, H, and the circuit is broken when the motor stops, but all the parts are ready for another operation and the circuit of the battery is left open.

The contact springs are ¼ inch apart from center to center, consequently the longitudinal lines on the paper on which the holes are punched must be ¼ inch apart. The transverse or time divisions may be ¼ inch or more apart. The distance will depend on the speed of the motor and the character of the music. In the example shown in Fig. 5 the transverse lines are ¼ inch apart; the music being composed entirely of quarter notes permits of this arrangement. This example shows the beginning and the end of the tune Vespers. The holes represent the position of the notes on the staff. It is a very simple matter to transfer any piece of music to a strip of paper ruled in the manner indicated, it being only necessary to remember that on the position of the note in the scale depends the location of the hole on the transverse line, while the relative positions of the holes on the longitudinal lines determine the time and the length of the notes.

The following is the music of the Westminster chimes for the first, second, and third quarter of the hour and the hour:

This music can be readily transferred to a strip of paper like that described. It is necessary to bear in mind that if, on paper divided as shown, one space represents the duration of a quarter note, two spaces would represent a half note, and four spaces a whole note.

G. M. H.

Guttaline.

A new preparation for the purpose of replacing India rubber and gutta percha has been brought out and protected by MM. Worms and Zwierchowski. To a quantity of Manila gum tempered with benzine is added 5 per cent of Auvergne bitumen, also mixed with benzine. These are thoroughly mixed together by mechanical means and by hand. By adding 5 per cent of resin oil and allowing 48 to 86 hours to pass between each treatment, a product is obtained having all the suppleness, elasticity, solidity and durability of the best India rubbers. If the product is too fluid, the addition of 4 per cent of sulphur dissolved by means of bisulphide of carbon will remedy this. The addition of 5 per cent of India rubber to this mixture makes an excellent compound for certain purposes. The vulcanization of this product can be carried out in the usual way.

The Florence (Mass.) Brush Industry.

BY H. C. HOVEY.

Long famous for its scenery, historic reminiscences, and educational institutions, Northampton, Mass., has during the past thirty years developed several important manufacturing enterprises. Most of these have been located along the winding course of Mill River, and several thriving villages have thus been created, which, after an era of independence, have finally been incorporated with the city already named. The largest of these suburbs bears the name of Florence, originally given on account of the Nonotuck Silk Works, whose elegant fabrics formerly found their way to market in Italian wrappers and were supposed to be imported from Florence, Italy. Here was also located an industrial community that patiently experimented with raising silk worms, to feed which groves of the Multicaulis mulberry tree were planted. Many other experiments, social, religious, political and educational, were tried in Florence, some of which succeeded while others failed. Among the most successful have been those connected with the manufacture of brushes of various kinds. The buildings used for the purpose, with about 30,000 surface feet of floor space, are not exteriorly remarkable, except for their romantic location on the banks of Mill River, and for their tasteful environs of lawns, ornamental shrubbery and flower beds, offering an agreeable contrast to the old-time dingy and odious structures once thought fit for the occupancy of operatives. By the courtesy of Manager Look and Superintendent Estabrook, the writer recently inspected the factory and obtained permission to give the observed facts to the public.

The enterprise has a unique history. The reader of Victor Hugo's works will remember the hero who, under the name of Father Madeleine, enriched himself and his community by certain ingenious imitations of jet and other "black goods." In 1819 the products of this process figured in the French Industrial Exhibition and gained for the inventor the cross of the Legion of Honor. The secret, which was probably never protected by patent, was brought to America by the late Mr. Critchlow, who afterward disposed of it to Messrs. Littlefield and Parsons, of Florence. A flourishing industry was thus created, the materials being pulverized sawdust and gum shellac, and various kinds of fiber, which formed a plastic dough easily moulded into daguerreotype cases and picture frames. By the addition of proper coloring matter the original "black goods" became red, green or yellow, and finally, in a peculiarly beautiful form known as lionite, a spotless white. The manufactured material accordingly resembled jet, gutta percha, lava or celluloid, as the case might be, and various fancy names were used by the dealers, though the common term at the factory was simply "union goods." The secret process was carried to New Haven, and perhaps other places, where similar factories were established; but the main and original factory in this country has always been at Florence.

About twenty-five years ago the suggestion was made that this plastic material might be well adapted for making the body and handles of brushes of various kinds. Practical difficulties arose, one of the most serious being that of fixing the bristles symmetrically in the dough while undergoing the enormous pressure to which it had to be subjected in the hot steel dies. To Mr. A. C. Estabrook belongs the main credit of overcoming these difficulties, and by his inventive genius and ability achieving the results now visible. Of course these novel processes are properly protected.

In the "blank room" the prepared ingredients in pulverized form are first mixed in suitable pails, scraps and parings being also worked in for the sake of economy, and then fed through hoppers upon pairs of rollers, one heated to 212°, and the other to about 100°, between which the mass is pressed into broad sheets. The sheet clings to the cooler roller, from which it is cut by an attendant, who passes it again between the rollers—cut and roll, cut and roll—until by this mechanical mixing the mass becomes homogeneous, when it is finally rolled out directly on a drawboard about eight feet long, where it is trimmed and cut into sheets of a convenient size for manipulation. Scrupulous cleanliness is insisted on. If the machinery stands idle for but a few minutes every part must be brushed clean before starting again. While the sheets, of whatever color, are yet warm and elastic, the blanks for use are cut from them by foot presses, and assorted in boxes according to size. To some of the blanks a harder degree is imparted than to the others by a certain process. The object of these two degrees of hardness is apparent when we come to see how the bristles are fixed in place. This was done formerly by inserting the tufts in perforated pieces of hard wood or metal, around which the composition was afterward moulded. But now the harder composition is substituted for the wood, the result being that the finished brush appears to be one solid piece, whereas it is really made of two pieces so perfectly united as to show no seam.

The bristles are mostly imported from Germany. Having been washed, combed, and "dragged," as well as this can be done by the eye and the touch, they are cut to exact lengths by a diminutive guillotine. Next they are inserted by hand, in little tufts, into perforated steel plates, at the exact angle and in the precise order in which they are desired to stand in the brush, and they are neatly trimmed by clippers. The ends projecting from the back of the plate are ingeniously singed by a blaze. The effect of this is to put a head on each individual bristle, so that it will always keep in place, even under the roughest usage. A cake of hot cement, of the harder kind, is then applied to the back of the steel plate, into which the heads of the bristles are sunk by pressure. Having been properly cooled and trimmed, the hard cake with its bristles still in the steel plate is ready to be joined to the body and handle of the brush. Preparatory to this the body blanks are made plastic again in small galvanized iron ovens. When sufficiently soft they are laid in steel moulds, upon which are also laid the bristle blocks, the two being clamped together. These moulds are cut by die sinkers with a great variety of ornamental designs, whose minutest features are faithfully reproduced under immense pressure. The moulds during this process are heated to 212°, in order to secure the desired result. From the hot presses the moulds go at once to the coolers, where formerly seventeen minutes were needed to cool them off. But this time is now shortened so that eight brushes can be made in nine minutes.

The means by which this is done is not only original and ingenious, but it actually seems to develop a new principle, the discovery of which is greatly to Mr. Estabrook's credit. The principle is that of *cooling by pressure;* and is correlated to heating by percussion. In other words, the heat is squeezed out. Ten coolers are at present used in the pressing room. Each steel mould containing a brush, mirror frame, or other object made of the plastic material is instantly subjected to a pressure of twenty-two tons. To satisfy myself, I applied a thermometric test. The steel mould was heated to 212° when subjected to pressure, and in eighty seconds it was reduced to a temperature of 60°, no agency except pressure having been employed. The pressure has to be augmented for larger surfaces to get the rapid result desired, as high a pressure as ninety tons being occasionally applied. This novel process may explain familiar phenomena that have had a different interpretation. Pressure pumps often get so cold as to be coated by ice. And, on the other hand, the ignition of punk by the sudden compression of air in a syringe is due to the fact that the punk takes up a portion of the heat squeezed out from the air.

Mr. Estabrook has also invented an hydraulic accumulator. As in use in this factory, it is four and a half feet in diameter and twenty feet high, with a vertical run of five feet. The cylinder carries ten tons of gravel. Its four inch piston gives a pressure of over twenty-two tons on the six inch piston of the cooling presses. The utility of the accumulator is that it gives an equal pressure at all times, without regard to the amount of water under the piston, whether it be half an inch or five feet.

Manicure goods, prophylactic tooth brushes, dental plate brushes, and other kinds of bone brushes are also made by this company, which it is aside from my purpose now to describe. The fact, however, may be mentioned as remarkable that from the four bones in an ox available for making tooth brushes only sixteen handles can be cut. It should be added, concerning all descriptions of the Florence brushes, that, by skillful devices, they are made very strong, as well as light and of graceful patterns. The edges only are polished by hand, while all other parts, being burnished by the steel dies, will retain their finish as long as the goods last. The material being impervious to water, and never absorbing impurities, is admirably adapted for use, from a hygienic point of view.

A California Earthquake.

The earthquake which occurred in central California on April 19 was felt mainly in a district 35 miles long by 25 miles wide. At Vacaville, Woodland, Winters, and Dixon a number of brick buildings were injured and many brick chimneys thrown down.

The shock was in a general north and south direction. It was not violent, but was rather long-continued. The light brick walls common to country buildings were not strong enough in the towns named to withstand the vibrations, and more damage was done near the center of disturbance than has been the case with any shock since that of 1872. No persons were killed and but few injured—none badly. The only building in San Francisco which was damaged was the old Academy of Sciences building, which was being repaired. The front wall, being improperly supported, fell.

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A GASOLINE STEAM CARRIAGE.

The steam carriage recently invented by Ransom E. Olds, of the Olds & Son's engine works, Lansing, Mich., proves to be such a practical success that we give herewith an engraving of its appearance, as photographed. The frame is made of steel arched over the forward wheels, and is low enough at the rear end to form a platform on which the engines and boiler rest fifteen inches from the ground, so that the engines are low enough to make connections on main axle in front, on which the cranks are placed at each end at right angles, there being an engine on each side with a 3×8 inch cylinder.

The boiler is upright and placed between the two cylinders on the rear platform, both engines being connected so as to work as one engine. Just behind the seat are the water and gasoline tanks. The water tank is sufficient for a ten or fifteen mile run, while the gasoline tank is sufficient for a forty mile trip. Over the entire vehicle extends a canopy top, so that the general appearance of the rig is like an ordinary surrey. The fire regulation is automatic, so that more or less gasoline is admitted to the burners as is required by the grade of the road, and when the vehicle is stopped it also closes off the gasoline so that the steam will not rise above its given point. The steering lever is adjusted so that any one can operate the steering, while the throttle and reverse lever are by the operator's seat.

It carries two passengers besides the operator and it is the intention to couple on another vehicle behind if wishing to carry more passengers. The steam from the engines is entirely done away with by an ingenious contrivance of the inventor, and there is no smoke. The engines couple on direct, so that there is no gearing whatever, and the rig runs as quietly as an ordinary carriage. The boiler and engines at the rear end are inclosed by curtains which shut out all view of the machinery, so there is nothing about it to scare horses and they do not seem to mind it any more than an ordinary carriage. Its usual speed on good roads is fifteen miles per hour, and it will ascend any ordinary grade.

The vehicle as a whole includes many new merits. Mr. Olds states that its great advantages are that it never kicks or bites, never tires out on long runs, and during hot weather he can ride fast enough to make a breeze without sweating the horse. It does not require care in the stable, and only eats while it is on the road, which is no more than at the rate of 1 cent per mile. Weight 1,200 pounds.

A GASOLINE STEAM CARRIAGE.

Mercury.

The striking and unique properties of mercury have caused it to be an object of interest and investigation since the earliest times. Being the only metal that is liquid at ordinary temperatures, it has many valuable applications in the arts; while its property of uniting with metals to form amalgams, and of not adhering to or wetting most other solids, renders it still more useful in many ways.

Mercury is a silver-white liquid metal of high specific gravity (13·54), freezing at a temperature of about 40° below zero—the only point where the Fahrenheit and Centigrade thermometer scales coincide. Its boiling point is correspondingly high, being 662° F.—a temperature readily produced in the laboratory, so that it can be distilled like water. The alchemists, in their vain search for the "philosopher's stone," held this metal in almost superstitious reverence, and distilled and redistilled it, hoping to be able to transmute it to gold or silver. A few grains of the precious metals, present as an impurity, were all that rewarded their efforts; but even these were sufficient to encourage them to further exertions, which, as must have been the case, resulted in nothing but a quantity of very pure mercury.

The most common ore of mercury is cinnabar, or the sulphide of the metal, which is mined principally in Austria, Spain, and California. The metal is separated from the ore by a simple process of roasting, by which the sulphur is driven off and burnt, while the mercury is set free in the state of vapor and condensed and collected in convenient receptacles.

When mercury is heated to the boiling point for some time in the air, it absorbs oxygen and becomes converted into mercuric oxide (HgO), a reddish powder. If this oxide is heated to a still higher temperature, it is again decomposed, oxygen gas is given off, and metallic mercury remains behind. This reaction is historically interesting as being the method by which oxygen was first prepared by the English chemist Priestley, and also by the French chemist Lavoisier, who first discovered the true nature of combustion, and recognized the pre-eminent importance of this element in the establishment of a rational theory of chemical philosophy.

Pure mercury will not adhere to glass, and this property renders it particularly useful in the manufacture of scientific instruments. Its regular expansion by heat is made use of in constructing thermometers; while its high specific gravity, which enables a column of mercury about thirty inches in height to balance a column of air of equal sectional area, renders it especially well adapted for barometers.

One of the principal uses of mercury is in the silvering of glass for mirrors. While, as above stated, pure mercury will not adhere to glass, it has the property of uniting with or dissolving other metals, forming compounds known as *amalgams*, which adhere very strongly to clean polished glass. In the manufacture of mirrors, an amalgam of mercury and tin is used. A sheet of tinfoil of the size of the glass is laid upon a perfectly level table and rubbed over with mercury, a thin layer of which is afterward poured upon it. The glass, previously cleaned, is then carefully slid on to the table, so that its edge may carry before it the superfluous mercury and the impurities upon its surface. Heavy weights are then placed upon the glass to squeeze out the excess of mercury, and after several days the amalgam is found to have adhered firmly to it. The process is one requiring much skill, and the workmen are liable to suffer from the poisonous action of the mercury vapor.

The amalgams referred to above are of great theoretical interest. The attraction of mercury for gold and silver is particularly strong, and a piece of gold dropped into a dish of mercury disappears like a lump of sugar in water. This attraction for the precious metals is taken advantage of in the extraction of gold and silver from their ores. Iron and platinum are the only metals which are not corroded by mercury, and it adheres even to the latter metal.

When mercury is triturated in a mortar with fine powders, such as chalk, which have no chemical action upon it, it loses its fluid character and forms a grayish or bluish powder, from which the common medicine known as blue pill is prepared. Although its metallic character is apparently unchanged, there is probably a partial oxidation to which the change is due.

The use of mercury in medicine originated with the alchemists, who sought in it the elixir of life as well as the philosopher's stone. The metal and its salts have a most powerful effect upon the human system, and, except in small doses, are extremely poisonous. In the treatment of certain diseases, mercury and its compounds are still found indispensable; but the promiscuous drugging with calomel, blue pill, and corrosive sublimate by former generations of physicians is now, happily, done away with. It is a curious fact that while *mercuric* chloride, or corrosive sublimate ($HgCl_2$), is a most powerful poison, *mercurous* chloride, or calomel (Hg_2Cl_2), is much less violent in its action, and is administered in comparatively large doses as a medicine. It is hard to see any reason on theoretical grounds why such a trifling difference in composition should confer such different properties.

Vermilion is a brilliant red pigment identical in composition with the ore of mercury known as cinnabar. Its brilliancy of color, however, depends upon the process of manufacture, and the Chinese still succeed in making the finest quality by their apparently rude methods.

Chemically, mercury is allied to copper, a metal from which it differs widely in its physical characteristics. From the specific gravity of its vapor and other considerations we learn that its molecule consists of a single atom, and we assume that many other metals are similarly constituted, although, owing to the high boiling point of most of them, we cannot make a direct determination.

The metal most resembling mercury in point of fusibility is the rare element gallium, which melts at 86° F., or less than the heat of the hand. When once melted, it remains fluid even if cooled far below this temperature; but if touched with a piece of the solid metal, it solidifies at once. In all other respects, however, the two metals are very different.

Among the minor uses of mercury we may mention the mercuric fulminate used in percussion caps, the amalgams used by dentists in filling teeth, and its occasional use in gilding and silvering. A few cases have been reported by physicians where several pounds of mercury were given to patients suffering from obstruction of the intestines, with the intention of forcing out the obstructing matter by the weight of the metal. Fortunately, this heroic method of treatment is "more honored in the breach than in the observance."

While not an indispensable metal, mercury is a very convenient and useful one. It is certainly very singular that only one out of the numerous metals known to us should be liquid at ordinary temperatures; but perhaps when the true nature of what we call the elementary bodies, and their connection with each other, are better understood, we may be able to discover a rational explanation for the remarkable differences in their chemical and physical properties.

Palm Oil.

The total import of palm oil into England is about 50,000 tons, valued at over £1,000,000, but it is considered that this is an exceedingly small commerce compared to what might be the case were the enormous resources fully, or even moderately, utilized. For miles along the west coast of Africa, extending between Cape Bianco and St. Paul di Loando, there are vast forests of palms, the oleaginous fruit of which has, for centuries, rotted unused upon the ground. The oil palm forests at the back of the coast line of Cape Palmas and Elmina are said to be practically inexhaustible; and so also in the neighborhood of Fernando Po immense tracts are covered with the trees.

Lagos furnishes the purest oil; for there are in commerce regular and irregular oils. When analyzed, if the water and impurities exceed 2 per cent, an allowance is made; for often these oils contain 10 to 15 per cent of water and impurities.

Palm oil is eaten as butter by the natives, and used for anointing their bodies. In England it is used in the manufacture of soap and candles, and in South Wales in the preparation of tin plates. Its non-drying qualities render it valuable as a preservative of the surface of the heated iron sheet from oxidation until the moment of dipping into the bath of melted tin, the sheets being rapidly transferred to that from the hot oil bath, which consists almost entirely of palm oil.

In 1871, as well as in 1880 and 1891, the imports of palm oil into the United Kingdom exceeded 1,000,000 hundredweight. From 10,000 to 15,000 tons of palm oil are shipped direct from Africa to the Continent. The price of the oil has ranged from 35s. per cwt., in 1883, to 23s., in 1890.

THE Bureau of the American Republics is informed of the completion of the Grand Trunk Railway of Uruguay from Montevideo 362 miles north of Rivera on the Brazilian frontier. The works were begun in August, 1888. The immediate result of this line to Brazil will be to open up a vast tract of fertile land hitherto comparatively valueless. The Brazilian government is now constructing a railway south from Rio Grande to Polotas, which will soon reach the boundary and furnish direct railway communication between Montevideo and those two important cities of Southern Brazil.

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RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR BRAKE.—John W. Neumann and John R. Pflanz, Louisville, Ky. This improvement is more especially designed for the motor car of street cars, the invention providing also a novel form of mechanism for the trail cars, by which the coupling devices will operate the brakes on the latter as the motor car is stopped. Pivoted operating rods are connected with pitman rods attached to the brake beams, and a longitudinally slotted drawhead having depending sides is combined with a wedge-shaped drawhead and a friction roller, the braking of the motor, car causing the wedge-shaped drawhead, as the trail car moves forward, to ride on the friction roller and depress the operating rods, thereby applying the brakes of the trail car.

CONDUIT TROLLEY. — James J. Cosgrove, Jr., Philadelphia, Pa. This is a simple form of trolley adapted for use with a continuous metallic circuit, and which may be easily adjusted vertically. Downwardly converging arms have their upper ends fitted to slide on ways on the under side of the car, two axles being mounted in the lower ends of the arms and a trolley pulley on each axle, the inner ends of the axles being inclosed by a casing, and there are connections between the pulleys and the motors, while cables are secured to the casing for raising the arms.

Mechanical Appliances.

LATHE CENTER. — William C. Roe, Honolulu, Hawaii. This center has a conical point from which leads a bore at an incline, a removable lubricating receptacle having an outlet tube entering the bore, while a distributing groove leads from the point of the center along its conical portion. By this means the point and the work revolving thereon are supplied with a lubricant to reduce the friction, thus keeping the point of the center true and accurately round during the time the work is revolving on the center, and producing perfectly turned work.

WOOD WORKING MACHINE DEVICE.—Watson T. Webb, Salt Lake City, Utah Ter. This invention combines a collar for counterbalancing the cutters on the spindle and a guard to prevent the operator from being injured by the cutters in case the work breaks. It consists of a washer having an elongated slot and adapted to be secured eccentrically on the cutter spindle next to the head carrying the knives or cutters.

Mining, Etc.

ORE CONCENTRATOR. — Crighton R. Townsend, Idaho Springs, Col. Inclined stationary flumes, connected and one below and in advance of the other, have transverse connected shafts at their ends, on each pair of which is mounted an endless belt with rakes to stir the solid contents of the flumes, to permit a free flow of water through them, and through doors in the bottoms, the invention also including other novel features. The machine is designed to practically take care of itself and run a long time without being cleaned up, handling a large quantity of material in proportion to its size, while being especially adapted for use in saving gold, quicksilver and amalgam, and concentrating crushed or ground rock, sand or earth tailings, etc. (For further particulars as to this invention address J. H. Morris, Whiting, Iowa.)

SLAG CAR. — Simon B. Dexter, Glendale, Montana. This car is for use in connection with an ore-roasting furnace patented by the same inventor, being used in connection with an elevator by means of which the track and car are moved upward until the car sides and ends come in contact with the bottom of the furnace. The car sides and ends are spring-supported, and there are locking levers for holding the car securely in a central position; the cars travel on a circular track, and the engagement of the lever of a full car by the lever of an empty car releases the former and allows it to pass by its own gravity. The floor of the car is lined with fire brick.

WATER-COOLED DAMPER. — This is a further invention of the same inventor, the damper being applicable to all ducts or flues where flame and hot products of combustion pass, while more particularly designed for use with an improved ore-roasting furnace patented by Mr. Dexter. The pipes forming the shaft of the damper serve to convey water to and away from it, and the damper is counterbalanced by weighted levers attached to the pipes near their free ends.

Agricultural.

THRASHING MACHINE.—John Weller, Funkstown, Md. This invention especially applies to improvements in the stop board or shutter, the shoes, and the blasts and parts connected therewith. The middle and lower shoes are supported in a manner to give a different movement from the upper shoe, whereby the grain will be subjected to a different influence on the middle and lower screens. The upper and lower shoes are operated reciprocally, the former with a long and the latter with a short movement, the former rising as it is moved toward either end and the latter descending as it is moved from its normal position in one or the other direction.

HARROW ATTACHMENT. — William O. Silvey, Middleport, Ohio. This is a positive working device, easily applied to any variety of plow, to thoroughly pulverize the turned-up soil, saving a separate harrowing, and the attachment may be turned up out of the way when desired. A shaft carrying a series of knives is journaled to project outward in rear of and beyond the mould board, and an operating handle or lever connected with the shaft extends adjacent to the hand-grasping portion of one handle, while a rigid brace rod extends from the forward end of the plow beam and has a bearing at its rear end in which the outer end of the shaft is journaled. The blades are designed to work the same whether supported on the plow handles, the plow beam, the plowshare, or any convenient part of the plow.

SEED PLANTER AND FERTILIZER DISTRIBUTER.—Joseph Laude, Monticello, Ark. This invention provides improvements in the construction of a machine formerly patented by the same inventor, the improvements relating more particularly to the hopper and its connections or attachments, and to the seed-dropping devices of the drum, the machine thus having a wider range of work and being comparatively less expensive to build and more satisfactory in use. By adjusting the driving chains, gear wheels, and seed delivery devices, the drum may be caused to drop any required quantity of seed for a hill, at any required distances apart, and either a fine or a coarse fertilizer may be dropped from the hopper in measured quantities.

Miscellaneous.

GRATE.—Frederick Carel and Wayland F. Davidson, Charleston, West Va. This improvement is designed more especially for a fireplace arranged to open into two or more rooms, there being fitted in such fireplace a revoluble grate having a partition dividing it into compartments, with fireboards or plates conformed on their inner edges to and fitted to the grate. The grate has a socket which fits on a journal on a base which may be readily moved into and out of the fireplace, and it is formed with its bottom dropped or curved downward at its outer edge, so that the fire can be arranged low and provision be made at the same time for pivoting the grate at its center.

COTTON BALING APPARATUS. — Edward D. Carter, Celeste, Texas. This is an improvement in machines in which cotton is formed into a continuous sheet or batting and then compressed, providing an apparatus in which the condensing and bat-forming devices press the lint cotton so close that its spring is broken, and avoiding the necessity of additional rollers between the condenser and the press box. The arrangement is such as to save room in the gin house, and means are provided for carrying off the dust and air made by the gin and condenser to the outside of the building, the baling operation being made continuous and inexpensive, and the bales being compressed to the required density without sending to another point to be further compressed by a more powerful cotton compress.

STAGE EFFECT. — Eva Heaton, Holly Beach, N. J. This invention providesan arrangement of machinery to produce a stage effect by means of which the spectators will apparently be transferred for a time to a coal breaker, representing the scene of a play. An inclined railway upon which runs a car extends across the stage, landings being arranged at the upper end of the railway and upon the stage beneath, and a stairway connecting the two landings, while there is a crusher at the foot of the lower landing and a chute extending from the upper landing beneath the railway and delivering upon the crusher, etc.

SEWING MACHINE NEEDLE. — Joseph E. Chenette, Johnstown, N. Y. The needle bar, according to this invention, has in its bottom a transverse recess from which opens a radial recess, and the needle held in the bar has a slit extending from the eye to a point adjacent to the recess in the needle bar, where a cam lever is pivoted adapted to be pressed upon one member of the needle. By turning down the lever an opening is made by which the thread may be readily passed to the eye, so that those with poor eyesight or trembling hands may readily thread the needle, or it may be threaded by any one much easier than can the ordinary machine needle.

SHALLOW WATER INDICATOR.—Alonzo G. Crossman, Huntington, N. Y. This device consists of a body adapted to be trailed at a depth below the vessel, and having at its lower side a projecting pivoted spear with which is connected a latch and trip mechanism. It is designed to be employed when a vessel is under way in shallow water or near land, being readily manipulated by any one of ordinary intelligence, and when the device engages the bottom an alarm is automatically sounded. The construction of the body is such also that the character of the bottom may be determined.

TYPEWRITER INKING DEVICE.—John R. Free, Ovid, Mich. A tube is supported centrally between the type bars and adapted to connect at its lower end with an ink bottle, a pad secured to the top of the tube being connected with the ink by means of a wick, while an inking cup flexibly connected with the upper end of the tube extends into the path of the type. The device may be applied to any kind of machine having the type bars arranged to strike a common center, and will thoroughly ink the type while preventing the ink from coming into contact with anything except the type. When one bottle of ink has been consumed, another is easily substituted.

BLOTTING PAD. — Robert Frost, Olympia, Washington. The pad holder, according to this invention, is composed of a spring plate doubled upon itself, one flat portion extending over the other, and the latter having slideways on opposite sides to hold the blotting material, which can be easily renewed when it becomes soiled. It is designed to fit snugly upon the fingers of a hand of any size, and not interfere with the turning of book leaves and similar work, while being always ready for convenient use.

MICROSCOPIC FILTER. — Porter W. Shimer, Easton, Pa. A graduated tube or receptacle is provided with a separate and independent plate to cross its lower open end, there being a filtering medium at the lower end of the tube through which the filtrate may pass out laterally and thus leave the deposit upon the plate for examination. A series of these filters may be conveniently arranged in a frame, and the improved apparatus may be used for separating out animalcules and solid vegetable and animal matter from water.

LEG FOR RADIATORS, ETC.—Wilbur N. Stevens, Ellenville, N. Y. This leg is built in sections, one adjustable upon the other, whereby, without disconnecting the leg from the article to which it is attached, the leg may be conveniently raised from the floor to admit of a carpet or other article being passed beneath it. The front of the leg is so made that, when resting on a carpet, should the adjustable portion be turned to carry the foot downward, the latter, while being pressed downward, will not turn, as the foot has a swivel connection with the section. By means of this leg, also, the article supported may be held straight, regardless of any irregularities in the floor or in the article supported.

CASH REGISTER AND RECORDER. — Albert R. Abbott, Boston, Mass. Combined with a series of keys are segmental gear wheels pivotally connected therewith, and an adding machine having a casing mounted to slide vertically, and provided with driving gear wheels adapted to engage the segmental gear wheels. The apparatus is simple and durable in construction, does not require frequent resetting, and is arranged to add up the various sales made, at the same time showing the amount of the individual sale and delivering a check or ticket on opening the money drawer, and also ringing a bell.

TRICYCLE. — Clarence R. Arnold, Wellsville, Ohio. Combined with a tubular rocking post connected with the drive wheels is an extensible post turning in the tubular post, and connected with the steering wheel to operate it, being provided with operating handles for the twofold purpose of steering and imparting a rocking motion to the tubular shaft. The invention also includes other novel features, the construction being simple and durable, the vehicle being readily propelled by both hands and feet, and steered and braked either by hand or foot.

BUTTER STAMP AND CUTTER. — William Hallenbeck, George W. Witt, and Walter Pattison, Hammondsport, N. Y. Combined with a standard is a loosely attached rack, an arm provided with a pinion engaging and encircling the rack, while a tubular knife is carried by the arm, and a plunger, operated upon by a lever, is held to move in the knife. The implement is of very simple construction, the knife being readily forced at will into the tub, whose position may be changed as its contents are taken out, while the knife may be conveniently carried to a stamp and the butter thereby be formed into rolls or pats.

PUMP AND MOTOR.—Thomas Henderson, Dallas, Texas. This is a device designed to raise water from a well or cistern to a tank at a higher elevation, or it may be placed on a pump instead of an air chamber and used as a feed pump for a boiler, or on a hydraulic ram as an auxiliary pump. It is a simple apparatus intended to be connected with a main water or service pipe, the fluctuation of pressure in the main operating the pump, so that there will be no direct consumption of water to run the motor and pump.

DEVICE FOR SECURING ANIMALS. — Joseph A. Hindman, Iuka, Ill. Combined with two side supports, which may be the sides of an ordinary stall for horses, is an intermediate post from which an upper and lower cross bar extends to one side, a spring-pressed gate bar extending on the other side, the improvement affording a safety device for breeding purposes.

WATCHMAKER'S PLIERS. — David Mendelson, Eureka, Utah Ter. These pliers have two pivoted members, one member having a concave lower jaw with a slotted free end and the other member having a rounded jaw carrying a removable punch adapted to enter the slot in the lower jaw. The implement is for quickly and easily removing the hands from watches and clocks without injury to the dial, center staff, or common pinion. The pliers are so made as to be also useful for many other purposes, such as fastening the bow of the watch pendant, rounding ear-ring wires, etc.

WINDOW BLIND. — Harvey Murdock, Brooklyn, N. Y. This is a simple and inexpensive form of sliding blind which may be readily pushed up out of the way and out of sight in a casing at the top, or readily held at any desired height. The blind consists of a series of slats hinged together and sliding in vertical grooves which extend upward to the opening in the casing, within which the slats fold one upon another.

TOWEL BRACKET.—William A. Neidhardt, New York City. This device comprises a two-part wall plate, one part being fixed and having outwardly extending arms and the other part having arms hinged to the arms of the fixed portion of the plate, the abutting arms supporting a roller and the space between the two pairs of arms being open to permit a towel to depend from the roller. The bracket is especially designed for use in public places, and its construction is such that it may be securely locked so that it cannot be removed except by unlocking it.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention and date of this paper.

NEW BOOKS AND PUBLICATIONS.

DIRECT LEGISLATION BY THE CITIZENSHIP THROUGH THE INITIATIVE AND REFERENDUM. By J. W. Sullivan. Twentieth Century Publishing Co. 1892. Pp. 120. Price 25 cents.

RAIN PRODUCED AT WILL. By Louis Gathmann. Chicago, Ill. 1891. Pp. 61.

This volume embodies four papers on man's control of meteorological phenomena, together with a copy of the editor's patent on a method for clearing the atmosphere.

THEORETICAL ASTRONOMY: DYNAMICS OF THE SUN. By J. Woodbridge Davis. New York: D. Van Nostrand Co. 1891. Pp. 156. Price $3.

This volume is the first number of the "Woodbridge School Essays." We have no room to review it *in extenso*. The eminence of the author and the elegance of the printing and paper give it unusual worth. Magnetism and electricity of the cosmic type receive special consideration. Illustrations are given when required, and mathematics are used with comparatively little frequency. A very full analytical contents is given as the index at the end of the work. A short contents termed "order of topics" precedes it.

WAYS AND MEANS. By A. H. Cleaves, M.E. Chicago: John W. Weston. 1892. Pp. xv, 158. Price $1.

Nearly everything in the line of minor mechanics, from gluing a broken chair to complicated lathe work and gear calculations, seems comprised within the compass of this production. But metal work is the main theme, and the numerous illustrations and practical nature of the text will, we imagine, make the work of value and interest to progressive mechanics.

EUHRER DURCH DIE BAUMATERIAL-SAMMLUNG des K. K. Naturhistorischen Hofmuseums. Von Felix Korper. Wien: R. Lechner, Publisher. 1892. Pp. viii, 355.

THE PRONUNCIATION OF FRENCH. By Charles F. Kroch, A.M. Hoboken, N. J.: Published by the author. No date. Pp. 61.

THE QUESTION OF SILVER. By Louis R. Ehrich, of Colorado. G. P. Putnam's Sons. 1892. Pp. 115. Price 75 cents.

This book contains several papers opposing the unlimited and free coinage of silver. He believes that the world's conference might however bring about genuine bimetalism and a fixed ratio of value of the two metals, gold and silver. The style of the composition is graphic, and the subject as treated is far from dry.

THE ELECTRICIAN PRIMERS. Vol. I. Theory. Vol. II. Practice. London: The Electrical Printing and Publishing Company. Pp. 284. Price $1 each.

These primers are virtually short tracts, each of from four to twelve pages in length, treating very attractively and with numerous illustrations of the science of electricity of to-day. We imagine that these brief treatments of the subject matters will be very acceptable to many readers.

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Centrifugal Pumps. Capacity, 100 to 40,000 gals. per minute. All sizes in stock. Irvin Van Wie, Syracuse, N.Y.

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For Sale—Patent No. 471,891, issued March 29, 1892, for brake shoe. This invention provides a brake shoe for road wagons, having a face which may be readily renewed, and is formed of a single casting. For particulars address Mark A. Penney, Perris, Cal.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

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Minerals sent for examination should be distinctly marked or labeled.

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(4352) A. V. F. asks: 1. Why is cyanide of copper better than sulphate of copper for plating? A. Because an alkaline solution will not corrode the metal upon which the copper is to be deposited. An acid solution will corrode some metals, and the thin film of oxide would prevent the adhesion of the copper. 2. Why cannot sulphate of aluminum be used as well as sulphate of copper for electrotyping? A. No method has been discovered as yet for using sulphate of aluminum for electrotyping.

(4353) T. H. B. asks: Is the trolley wire insulated or not? A. It is supported by insulators but has no insulating covering.

(4354) C. F. Van D. asks: 1. What kind of glass jars must I use in making Leyden jars? I have tried common fruit jars, also flint glass jars procured at the druggists'. The fruit jars give best results, but neither give even fair results. Is it in the composition of the glass? A. Use glass which contains no lead. A great deal depends upon the composition of the glass and the thickness of the walls of the jar. They should be rather thin. 2. I have constructed a Winshurst influence electrical machine, and get splendid results. It was made according to description in SCIENTIFIC AMERICAN some years ago. When I turn the handle, I notice that there is a very peculiar odor noticeable. Is this what is called "ozone"? Is it injurious to inhale the same, or otherwise? A. The odor you describe is due to ozone. It is not especially injurious, but if inhaled continuously will produce a headache, and curiously enough it often cures a headache.

(4355) E. H. A., Dallas, Texas, asks how to construct best a "polar chamber," and what to do with the injurious heavy drops of dew collecting on the cold walls? The hot weather here is upon us, and polar chambers would be perhaps a luxury, if not a health resort. A. The best arrangement for a "polar" or cool chamber is by the use of compressed air, say to a pressure of 15 lb. per square inch, allowing the air to cool to normal temperature in coils of pipe in the outer air, and then discharge in a closed room. This will give a temperature in hot weather in your climate of about 60° with very little cost for air compression. A windmill or gas engine may be used for compressing the air. We do not advise a lower temperature than above stated, if so low. The change on going in and coming out will be too great for health. The walls should never be cold enough to collect moisture or dew.

(4356) J. A. L. asks: 1. How much coal would be required to furnish 1 horse power for ten hours, if used by a fairly economical stationary steam engine? A. 60 to 80 pounds of good coal should run your engine ten hours. 2. Have been unable to prepare sensitized silver paper that would keep according to formula prescribed in query No. 3240 without getting a milky precipitate and small granular crystals on the paper. A. We think the precipitate is a chloride of silver. There may have been too much citric acid added. Try another brand of albumen paper. Sometimes this is defective. Another formula, said to be an improvement, is as follows:

Silver nitrate	2 oz.
Citric acid	1 "
Alcohol	1½ fl. oz.
Water	16 oz.

The paper is floated two minutes in hot weather, and three minutes in cold weather. It should be carefully dried and kept in a dry place.

(4357) F. H. T. asks: 1. In washing dry plates after developing or fixing can I use salt water (sea water)? If not, why? A. No, because in drying it will leave the plate covered with chloride of sodium or salt. 2. Why does the alum solution that I use for hardening the film discolor, and does it make any change in the ultimate result? If it does not, where does the coloring matter come from? A. The coloring of the alum is due to the developer left in the plate after washing and to the gelatine. By filtering the alum each time and keeping it in a stoppered bottle it can be used repeatedly. In hot weather it is advisable to use a fresh bath of alum for each batch of plates. Cramer's chrome alum solution is considered the best.

(4358) R. E. D. asks: 1. Will you kindly inform me what the tonnage of American vessels is at present, and what it was before the war? Is the American merchant marine increasing under the present administration? When the war vessels now being built are finished, will the United States navy be able to repel a naval invasion by any foreign country, and protect our ports from bombardment? Is farming by irrigation being employed to any extent in the Western and Pacific States and Territories? A. The largest tonnage built in any one year was in 1855—533,000 tons. Since then it has varied in different years from 100,000 to 250,000. The total tonnage of the United States is about 4,000,000 tons and has steadily increased. We think the United States is amply able to repel any attack from a single nation. An invasion is out of the question. Irrigation is largely on the increase in the Western States, and will eventually become the means of farming thrift over millions of acres of our arid lands.

(4359) C. L. K. asks: 1. What is the black incrustation which forms on the zinc plate of a gravity battery. Does it increase the internal resistance? My zincs are made from scrap sheet zinc. When it is dissolved in nitric acid, and ammonium hydrate is added, a bluish precipitate falls. How can copper form there when the zinc does not come in contact with any copper sulphate? A. The black incrustation referred to is metallic copper in a finely divided state. Probably a little copper sulphate is mingled with the zinc sulphate. 2. Why is the incrustation harder to remove when the battery (36 cells) is working through 2,000 ohms than when 1 cell is working through 10 ohms? Merely jarring the zinc will remove it in the latter case, while it takes hard and continued scraping to get it off in the former. A. In the case of 36 cells, probably owing to the greater resistance of the circuit, a greater amount of copper was deposited upon the zinc. 3. Does an abundance of precipitated copper on the copper plate increase the internal resistance? A. It has the opposite effect. 4. Will zinc sulphate crystallize over the edges of the jars before the solution is saturated? A. It is always liable to do so. 5. Why are not the coils of a sounder made of German silver wire instead of copper. Its price per ohm is much less than copper, and the coils could be placed much nearer the magnets? A. It is a mistaken idea to suppose that resistance alone adds any efficiency to a magnet. It is a question of ampere turns. If the ampere turns can be secured in a magnet without any resistance, so much the better. The use of German silver for magnets would be something like drawing steam through a coil of small pipe when a large straight pipe could be used for the same purpose.

(4360) W. H. P. asks: 1. What are the data and process for computation of the motive power to be obtained from the flow of an artesian well? A. The water power of an artesian flowing well may be obtained by measuring the quantity of water delivered at the highest available point in cubic feet per minute. Multiply by 62½ pounds to a cubic foot and by the height of available flow in feet from the ground and divide the product by 33,000 pounds for the gross horse power. Of this you can utilize from 60 to 80 per cent for power by water wheels or turbines. 2. Is there a method of connecting and firmly uniting pieces of vulcanized rubber; car spring rubber for example? A. For firmly cementing rubber springs together use rubber cement prepared for vulcanizing and heat in a vulcanizing oven. Composite cements will not stand the elastic strain on car springs. No perfect way of uniting vulcanized rubber is known.

(4361) A. F. H. wishes to know how old faded photographs can be restored. A. The print is removed from the mount by soaking in warm water. Then it is immersed in a weak solution of bichloride of mercury and warm water, 10 grains of the bichloride to 4 ounces of water. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 451, for full directions.

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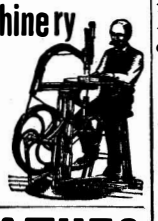
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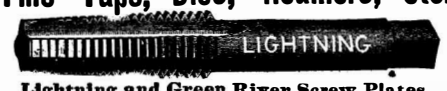

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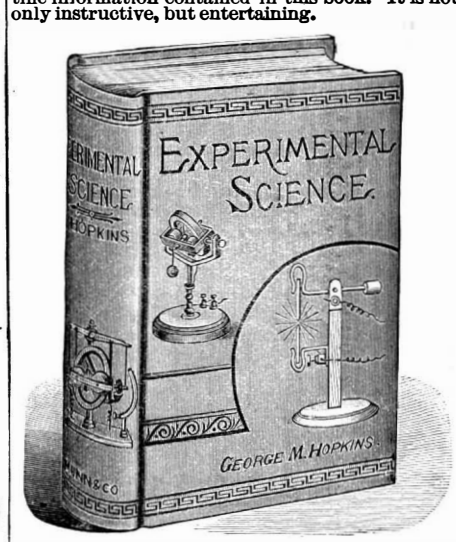

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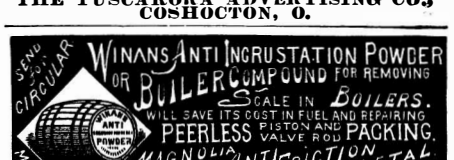
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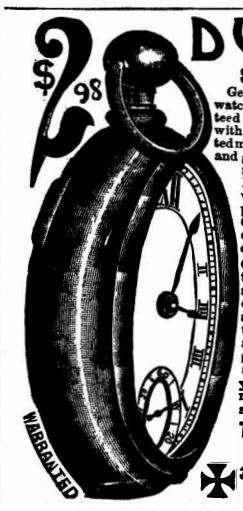

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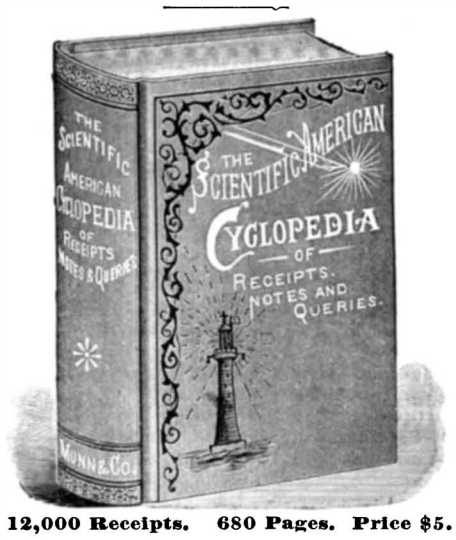

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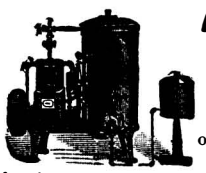

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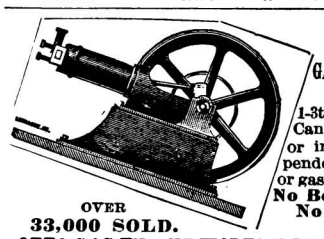

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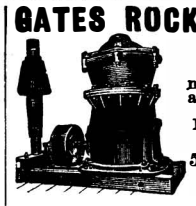

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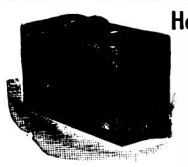

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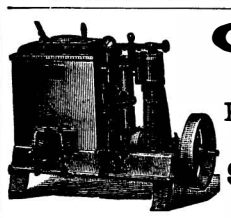

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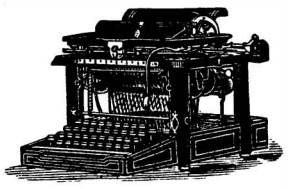

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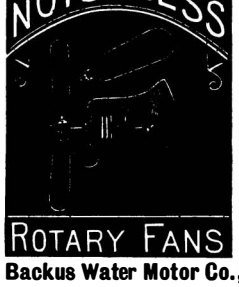

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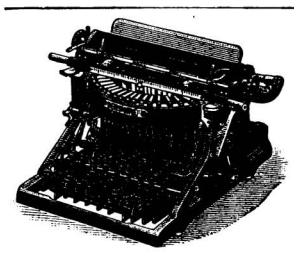

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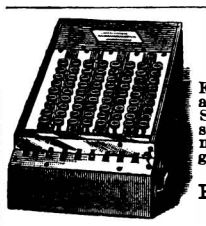

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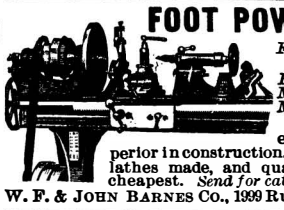

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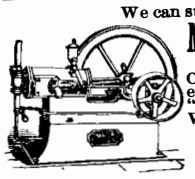
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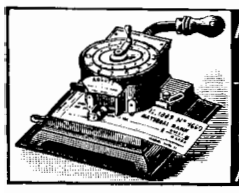
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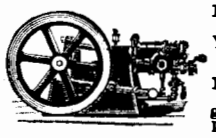
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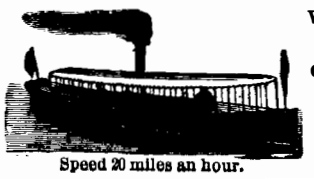
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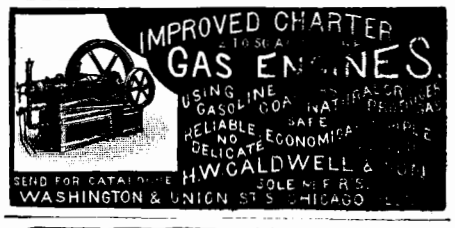

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